ELECTRICAL WORLD
AND
Electrical Engineer.

ELEC. WORLD, VOL. XXXIII., No. 11. NEW YORK, MARCH 18, 1899. ELEC. ENGINEER, VOL. XXVI., No. 567.

PUBLISHED EVERY SATURDAY BY

ELECTRICAL WORLD AND ENGINEER (Inc.),

9 MURRAY STREET - - NEW YORK.

TELEPHONE CALL: 924 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

CHICAGO OFFICE, - - - - - - - Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - 929 Chestnut Street.

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TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - per year, $3.00
Foreign Countries within the Postal Union, - - - - 6.00
Single Copies, - - - - - - - - - - .10

In requesting your address changed give OLD as well as new address.

[*Entered as second-class mail matter at the New York Post Office.*]

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The combined paper, the ELECTRICAL WORLD AND ELECTRICAL ENGINEER, of which the issue of March 11, 1899, was the first number, will hereafter be sent to all subscribers of THE ELECTRICAL WORLD and of THE ELECTRICAL ENGINEER in accordance with the separate lists of those two journals. Where subscriptions overlap, credit will be extended to the full amount of the unexpired term of the payment, the price remaining as before, $3 per year, for 52 weekly issues. Prompt notification is earnestly requested of any failure to receive the new journal.

NEW YORK, SATURDAY, MARCH 18, 1899.

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SUBJECTS FOR MONUMENTS.

A long list of subjects has recently been compiled for the American Architectural League by a special committee appointed for the purpose of noting the State and city events worthy of commemoration by monument. Historical and patriotic societies have lent their aid, though it does not appear that scientific bodies have been called upon for recommendations. The result, as shown by the preliminary list, is very interesting and suggestive, and the topics may be said to range from Hudson to Hobson. Naturally enough, nearly all the earlier dates mark events of a social and constitutional nature, but the subjects named for the present century have scientific discoveries and industrial advances fairly well sprinkled among them. The list is inadequate, however, from the electrical standpoint; although in a city where among very few statues Morse and Franklin have been remembered we shall not urge serious complaint. For 1843 the submarine cable of Samuel Colt, from Coney Island and Fire Island, is cited; for 1846, the opening of the New York-Philadelphia telegraph line; for 1867, the completion of the Atlantic cable; and without specific date, the introduction of electric lighting. But what of the first telephone, the first street car, the first trolley, the first fire alarm, the first phonograph? While we do not expect a monument or tablet for all these and sundry others, the list strikes us as obviously in need of reconsideration.

SOUTHERN CALIFORNIA TRANSMISSION PLANT.

The longest electrical transmission line ever built for commercial service (81 miles, exceeded in length only by the classical Lauffen-Frankfort experimental line) is that of the Southern California Power Company, a description of which appears on other pages of this issue. The pressure used, 33,000 volts, is exceeded by only one other plant in the world, that at Telluride, Col., which carries 40,000 volts. This long transmission and the consequent high pressure is justified in southern California by the high cost of coal and the low cost of water power. The latter, in many instances, in southern California—and notably in the plant referred to—costs practically nothing, as the hydraulic works are utilized for collecting, storing, transmitting and distributing the water from the mountains to irrigation districts in the lowlands, and may be so built as to utilize for power purposes whatever head is available, with practically no increase in the cost of the hydraulic development. In fact, the utilization of the head is a distinct advantage, as the great difference of level between the source of supply and the districts to be irrigated gives otherwise to the water an energy the absorption of which is a matter of difficulty.

ELECTRICITY IN THE ITALIAN AND AMERICAN NAVIES.

On other pages will be found the first installment of a very complete article on the present situation in the Italian navy with respect to the application on shipboard of electricity to lighting, power and signaling. Several years ago an article by the same writer on this subject appeared in these columns, and a comparison will show that a very considerable advance has been made in the

interim, both in apparatus and in extensions of applications. The present policy of the Italian navy is to extend the application of electricity aboardship to the utmost limit, not only in ships now building, but also in older vessels by very considerable additions to the original plants. This policy is in striking variance with that lately adopted by our naval authorities, which stops further advances on the ground, as we are led to surmise from the recent report of the bureau chief having cognizance of the electrical engineering department, that the present electrical personnel aboard our war vessels is not competent to properly care for even the present meagre equipments. Should this statement of cause be correct, it implies a condition in this branch of the naval service that demands serious attention—a condition which condemns the system under which it arises, and which leads to an utterly unmerited reflection on the American electrical industry and on American electricians.

THE WEHNELT INTERRUPTER.

Professor Thomson's further experiments with the Wehnelt electrolytic interrupter, detailed in another column, are not only of great interest, but also of considerable practical importance. The electrolytic interrupter is much simpler to construct than the ordinary spring vibrator of an induction coil, and is evidently capable of a much greater range in frequency. The frequency obtained with an ordinary spring vibrator rarely exceeds 250 periods per second, and although it is possible to employ special forms capable of much higher frequencies, these are difficult to control and adjust. Particularly is this the case with 110-volt circuits. It would seem that almost any frequency up to 1700 periods per second can be obtained with the use of one or more of these electrolytic interrupters on ordinary 110-volt circuits. By the use of these interrupters it should be possible greatly to simplify the Roentgen-ray outfit. It is very fortunate that such an outfit may be operated, as Professor Thomson describes, from either continuous or alternating pressures.

It would seem that the cause of these remarkable phenomena is the rhythmic sealing and unsealing of the anode conducting surface by the electrolytically liberated gas. The rate at which the gas can form depends upon the e. m. f. in the circuit, the resistance and the inductance, while the rate of sealing will depend both upon the amount of free surface and the current strength. Consequently, the higher the pressure and the lower the inductance of the circuit, the quicker the surface is sealed up and the higher the frequency automatically attained. If the efficiency and durability of the apparatus are found in practice to be as great as these experiments indicate, the discovery has a wide field of commercial application.

ANOTHER HUNTER PATENT.

Mr. R. M. Hunter has added still another to his list of "broad" patents, in one issued March 7, purporting to cover the application of alternating currents to electric traction. In this patent there are fifteeen claims, which, stripped of technical verbiage, maintain as an invention the application of the alternating currrent in electric railway distribution and operation. Of course, the old-time combination claim appears, one reading as follows: "In an electric railway, the combination of an alternating generator, a vehicle or vehicles moving along a track, a motor or motors mounted upon said vehicle or vehicles, an inductional transformer or transformers interposed between the generator and the motors, and connections comprised wholly or in part of the rails for carrying the current fom the tension-changing devices to the motors." The application for this patent was filed October 21, 1889, at which time alternating-current distribution for electric lighting and the electric railway had both reached a stage of development practically that of to-day. Yet, after ten years' consideration, the Patent Office indorses as descriptive of an invention the above and fourteen similar claims of the patent.

Mr. Hunter is now the happy possessor of "fundamental" patents on the electric railway as a whole, on commercial alternating-current lighting and on the application of the alternating current to electric traction. Were patents in themselves accepted as legal evidence of invention, those above mentioned would practically control the entire electrical industry. The wisdom is therefore apparent of the requirement, that before a monopoly is assured to an invention its right to such monopoly must, if challenged, be established in court by proof both of priority and invention. Of the several previous patents of Mr. Hunter that have been claimed to cover the arts to which they apply, none, we believe, has yet been submitted to this ordeal, though every electric railway and every alternating-current plant have for years been infringing their claims—in fact, could not operate without such infringement.

CENTRAL STATION DESIGN.

The problems of central-station design are not of easy solution, even for a small plant. The ideal of simplicity to which early managers looked forward, when they hoped to replace sundry small unrelated units by one big generator, has steadily receded; and the colossal stations of the present day, where these large machines of four or five thousand horse-power apiece stand in rows, present their own special difficulties that did not enter into contemplation when the art was young. Relatively to the demand for current, indeed, the units of 1899 are no larger than those of 1889, and in addition to all the old questions of balance, regulation, economy, etc., are new ones, due to the adoption of high-tension methods of transmission and the use of substations.

To New York City the eyes of American electrical engineers in general have always been turned, the work of the New York Edison Company being regarded as steadily typical of the best practice. It may fervently be hoped that under the coming régime good technical counsels will still prevail, and while the latest plans evolved by the old management may not be executed, they are none the less interesting. Our issue this week presents the latest ideas in station work of Mr. Bowker and his associates, and the data given are well worthy of study. Only one point will here be emphasized, namely, the prominence given to superheating of steam. So far as we are aware, this is quite a novelty in American central station practice, but German and English results justify its adoption, by promising economy not hitherto attained. In a paper read before the Northern Society of Electrical Engineers, of England, Mr. Paul Schou noted recently the fact that over 200 complete plants are working successfully in Europe on the Schmitt system of utilizing highly superheated steam, among them a 750-hp plant, which has been running 3½ years, night and day, continuously, without the slightest hitch. This engine is used for a mill rolling fine steel sheets, with the engine power varying from 400 to 750 horse-power, with a reported consumption of 8¾ lbs. of steam per indicated hp-hour, a result which Mr. Schou safely pronounces the best ever obtained in any steam engine in the world. The boilers are heated with producer gas, the consumption being equal to 1 pound of coal per indicated hp hour. Careful tests on a 70-hp tandem compound engine, made by Mr. Schou, showed a steam consumption of 10½ pounds

per indicated horse-power and a coal consumption of 1.4 pounds per indicated horse-power. Central stations, even if already on a dividend basis, may well regard such figures with envy.

LIQUID AIR FALLACIES.

In the March number of "McClure's Magazine" appears an interesting article on liquid air in its present and prospective uses. This article contains much that is interesting, presented in an attractive manner, but to technical readers some of its suggested possibilities are so manifestly impossible from the standpoint of the conservation of energy that we cannot, seeing such hopes held out in print, refrain from protesting against them. The hope is fostered and the possibility suggested of producing 10 gallons of liquid air from the energy developed by a liquid-air motor consuming 3 gallons of liquid air in the process. In other words, if 3 gallons of liquid air be put into a liquid-air engine, then it is claimed that the engine will be able to compress and liquefy air to the extent not merely of 3 gallons, but even of 10 gallons. Were this true, it would be evident that by continuing the operation of engines of this character we could—starting with 3 gallons of liquid air—produce an unlimited quantity of this material, and if such engines were allowed to work indefinitely, which of course they could do if they required no extraneous energy to drive them, the whole atmosphere on the surface of our globe might ultimately become liquefied. The mere suggestion of this consequence should prove a reductio ad absurdum.

If we take two air chambers provided with heat-tight walls, it is theoretically possible to place a heat engine between them, and by supplying energy to this engine to transfer heat from the air in one chamber to the air in the other chamber, thus lowering the temperature in one chamber and raising it in the other. Continuing this process, the air in one chamber would eventually be cooled to the temperature of liquefaction, the air in the other chamber being raised in temperature by the heat so abstracted. By reversing the process it is theoretically possible to let the engine perform work by absorbing the heat from the heat chamber and restoring it to the liquefied air in the cold chamber until, when equality of temperature is restored to the two chambers, the work performed by the engine would be theoretically equal to the work expended in the original process. It is evident, therefore, that even assuming a perfect engine and no loss of heat, it would only be possible to obtain from the chamber of liquid air used as a refrigerator the same amount of energy that was developed in the liquefaction of the air. In practice, owing to the rejection and waste of the heat evolved in the process of liquefaction, as well as to the loss of heat energy and to the imperfection of the engine, it would manifestly be impossible to regain more than a small fraction of the energy expended in the process of liquefaction, so that every gallon of liquefied air would not only be incapable of producing from air at the ordinary temperature an amount of power necessary to liquefy a gallon, but could in point of fact only supply power for the liquefaction of a small fraction of a gallon.

The dissemination of such irrational views, even in a non-technical journal, is not only misleading to the general public from inaccuracy but is actually anarchistic and immoral. The great lesson that Nature forces upon us is, that nothing is to be had from her for nothing and very little for a penny. The doctrine that from nothing much can be obtained is on a par with the doctrine that all men can be made rich by the mere act of legislation. Such ideas are opposed to true education and civilization. Nature's price list for energy is fixed, and no jugglery can change it.

Without straining after the sensational by purloining upon the precincts of the impossible, it suffices to direct attention to the enormous wastefulness of the processes upon which we are dependent at the present day for the great bulk of our useful mechanical power. Nearly all of this power is developed in steam engines and these, although marvels of ingenuity, are exceedingly wasteful means of transforming chemical into mechanical energy. The efficiency of boilers is fairly good, being not unfrequently 80 per cent.; but the efficiency of the best engines scarcely exceeds 20 per cent., and, in fact, this efficiency is only reached in comparatively rare instances. The combined efficiency of engine and boiler, with reference to the heat energy in the coal, is, therefore, rarely as high as 16 per cent. Strictly speaking, of course, the best engines should not be regarded as wasting 80 per cent. of the power they receive, since an ideally perfect heat engine would, under the same conditions, only be capable of utilizing about 35 per cent., so that the efficiency of the best engines is nearly 60 per cent. with reference to the behavior of ideal heat engines working between the same limits of temperature. When we consider, however, that engines in common practice give results considerably below these figures, and commonly deliver only about 5 per cent. of the energy resident in the coal they burn, it is evident that enormous room for improvement exists in the direction of transformation of energy.

The efficiency of refrigerating machines is practically the only efficiency which is commonly stated as being in excess of unity or 100 per cent., and is, therefore, an apparent exception to the general rule that an efficiency may not be greater, and is usually appreciably less, than 100 per cent. In some cases the efficiency of an ammonia refrigerator expressed as the ratio of the heat energy withdrawn from the refrigerating room to the mechanical energy expended by the compressor in the process is over 4, i. e., over 400 per cent. This high nominal efficiency has sometimes led to the erroneous belief that refrigerating plants were capable of practically creating energy. The reason for this high nominal efficiency of the refrigerator lies in the fact that under acknowledged thermo-dynamic law some four units of heat energy have to be transferred from a furnace at the temperature of 100° C. to the cooling chamber at a temperature of 7° C., in order to liberate 1 unit of mechanical energy in a perfect engine working between the two. In other words, the theoretical efficiency of the engine would be only about one-fourth, or 25 per cent. But all perfect heat engines are reversible. It therefore follows that if the operation of such an engine were reversed each unit of mechanical energy supplied to the engine would bring about the transfer of 4 units of heat energy from the cold chamber to the hot chamber, or the efficiency of the process would be 400 per cent. But, of course, this high efficiency is of no practical value in the production of mechanical power, since on again reversing the engine it would take 4 such units of heat energy to give out 1 unit of mechanical work. This use of the word efficiency in regard to refrigerators, unless carefully defined, is unfortunate.

A still more unfortunate use of the word "efficiency" is in general circulation in connection with incandescent lamps, in which the efficiency is usually defined as the ratio of the power absorbed by the lamp in watts to the intensity of illumination emitted by the lamp, expressed in candles. This definition is unfortunate, not only because it is a ratio between two entirely different physical quantities, but also because the more inefficient a lamp actually becomes the higher is its efficiency when so expressed.

Steam Pump Consolidation.

It is announced that papers of incorporation for the consolidation of the leading steam pump manufacturers in the country will be filed at Trenton, N. J., shortly. The consolidated companies will be known as the International Steam Pump Company. It will be capitalized at $27,500,000, of which $12,500,000 will be in 6 per cent. cumulative preferred stock and $15,000,000 in common stock.

These companies will be absorbed in the consolidation: Henry R. Worthington Company, of Brooklyn and Elizabethport, N. J.; Blake & Knowles Steam Pump Company, of East Cambridge and Warren, Mass.; Deane Steam Pump Works, of Holyoke, Mass.; Laidlaw-Dunn-Gordon Company, of Cincinnati, and the Snow Steam Pump Works, of Buffalo, N. Y. The net earnings of these companies are placed at $1,211,973, and they handle over 90 per cent. of the steam pump business in this country. The combined assets are put at $11,981,355. Charles C. Worthington will be the president of the International Company, and Max Nathan, the president of the Nathan Manufacturing Company, will be the treasurer. C. C. Worthington, Max Nathan, William Lanman Bull, T. F. Miller, Charles L. Broadbent, Marcus Stine, Lewis E. Bellows, John G. Mackintosh, Robert Laidlaw, John W. Dunn, Daniel O'Day, James H. Snow, Philip Lenman and E. F. C. Young will be directors.

Large Electric Traction Gains in Chicago.

The business of the Chicago Metropolitan and South Side elevated railroads continues in very satisfactory volume. The final returns for the February traffic on the Metropolitan are not in hand, but the approximate daily average of passengers carried was 76,000. For the corresponding month of last year it was 66,977, the increase being about 9000 a day, or between 13 and 14 per cent. A favorable comparison is made with the preceding month of this year, the January average having been 72,338. The present volume of traffic passes the average for last November also, and February's daily record is the second highest in the history of the road, being exceeded only by December, 1898, when the average was 77,200.

The record of the South Side Elevated for the month is equally favorable. The daily average approximated 60,000, as compared with 52,691 for the month of February, 1898, an increase of something like 7,300, or nearly 14 per cent. As in the case of the Metropolitan, the daily average was exceeded only in December of last year, when it was 62,735. The actual and proportionate gain, as compared with the corresponding period of the previous year, was, however, greater than in December. November, 1898, increased over November, 1897, 4961 passengers a day, or 9 per cent.; December, 5961, or 10 per cent.; January, 6642, or 12 per cent., and February, about 7300, or nearly 14 per cent. These comparisons are all with periods of 1897-98 during which the Union loop was in use, and indicate a steady development of business.

Legal Use of Highways for Poles.

The question of the right to erect poles on highways has again come up recently in New Jersey and New York, with the result of a differentiation being made between services. In New Jersey a decision has just been rendered by the Court of Errors and Appeals to the effect that the use of a highway for the erection thereon of telegraph or telephone poles is not a use which can be authorized without providing for compensation to abutting property owners who have a fee in the bed of the highway. In thus holding the court seems to have followed the Court of Appeals of New York State, which, in 1894, through Judge Rufus W. Peckham, declared that "neither the State nor its corporation can appropriate any portion of the public highway permanently to its own special, continuous and exclusive use by setting up poles therein, although the purpose to which they are to be applied is to string wires thereon and thus to transmit messages for all the public at a reasonable compensation." The New York Court of Appeals has also handed down an important decision within the past week, which establishes some interesting propositions in regard to this subject of lighting highways. Light, being an aid to the public in traveling upon a highway in the night time, subserves a street purpose, and in cities and incorporated villages it is declared to be not only a right but a duty of the municipal authorities to supply it. "Not so with telegraph and telephone wires," says Judge Haight. "They in nowise preserve or improve the streets or aid the public in traveling over them." The placing of the necessary poles and wires for lighting a highway must therefore be deemed one of the uses for which the land was taken, and does not impose upon it an additional burden for which an abutting owner is entitled to compensation. This rule is held to apply to rural districts, as well as to more thickly populated localities, if the inhabitants are willing to pay the expense. The court intimates, however, that if the highway be only a country road, sparsely traveled and where no necessity exists for light, a taxpayer might object effectively.

Clyde Jones on Patent Systems.

An interesting paper was read by Mr. W. Clyde Jones, on March 3, before the Chicago Electrical Association, entitled "Patent Systems of the United States and Foreign Countries Compared." While it covered ground familiar to most of our readers, it was an admirable presentation of the various methods and systems, their resemblances and their dissimilarities. Mr. Jones noted nine principal differences, as follows:

1. The United States protects the inventor by granting the patent only to the first and original inventor, while some of the foreign countries grant the patent to the first to apply.

2. The United States provides an examining corps to assist the inventor in determining the state of the art and the true scope of his invention, whereas most of the foreign countries grant the patent as requested, without inquiry as to novelty.

3. The United States gives to the inventor a preliminary period of two years within which to try his invention by public use to determine its practicability and value, before applying for a patent, while in foreign countries the knowledge or use of the invention in the country prior to the application invalidates the patent.

4. The United States places no requirement upon the practicing or working of the invention, while foreign countries usually require the putting of the invention into practical operation within a definite period.

5. The United States places no restriction upon the importation of the patented device, whereas such restriction is imposed by some of the foreign countries.

6. The United States requires the payment of no taxes after the grant of the patent, whereas the foreign countries usually exact a yearly tax or annuity, increasing from year to year, the failure to pay which causes a forfeiture of the patent.

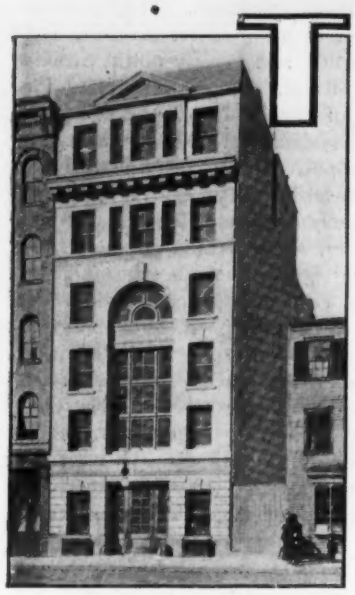
7. In some of the foreign countries a compulsory grant of licenses is provided for, where the patentee refuses or is unable to fill the demand for the article, while in the United States compulsory licenses are not provided.

8. In the United States the term of the patent begins to run from the grant of the patent, while in the foreign countries the term usually dates from the filing of the application.

9. Some foreign countries provide that the domestic patent shall expire with the first foreign patent to expire on the same invention. About a year ago a similar provision in the laws of the United States was repealed.

In general, Mr. Jones was favorable to the retention of the present American system, and said: "While it is apparent that in our system some objections and abuses may arise, they are not due to the general provisions of the system, but rather to the lack of specific provisions for checking the particular abuses, and these will, it is believed, be in time remedied, but not by radical changes or the adoption of the cumbersome provisions of foreign systems, although we may derive suggestions from their practice. As to the practical effect of the American system, a comparison of the patents granted by the United States and foreign countries shows that up to the year 1898 the United States had granted 626,327 patents, France 297,166, Great Britain 265,870, Belgium 146,772, Germany 118,694, Austria-Hungary 82,933, and Canada 65,489. The United States thus stands head and shoulders above all the other nations, having granted more than any two of the other countries. During 1898 there were over 36,000 applications for patents filed in the United States, while in Great Britain there were about 30,000 applications filed. Practically all of the applications in Great Britain mature into patents, many of which are invalid by virtue of previous patenting, since no examination as to novelty is made. During the year 1898 22,207 patents were issued in the United States, after examination, and at the end of the year there were 6824 applications allowed and awaiting the payment of the final fees, while 4363 applications had been allowed, but had been forfeited for the non-payment of the final fees."

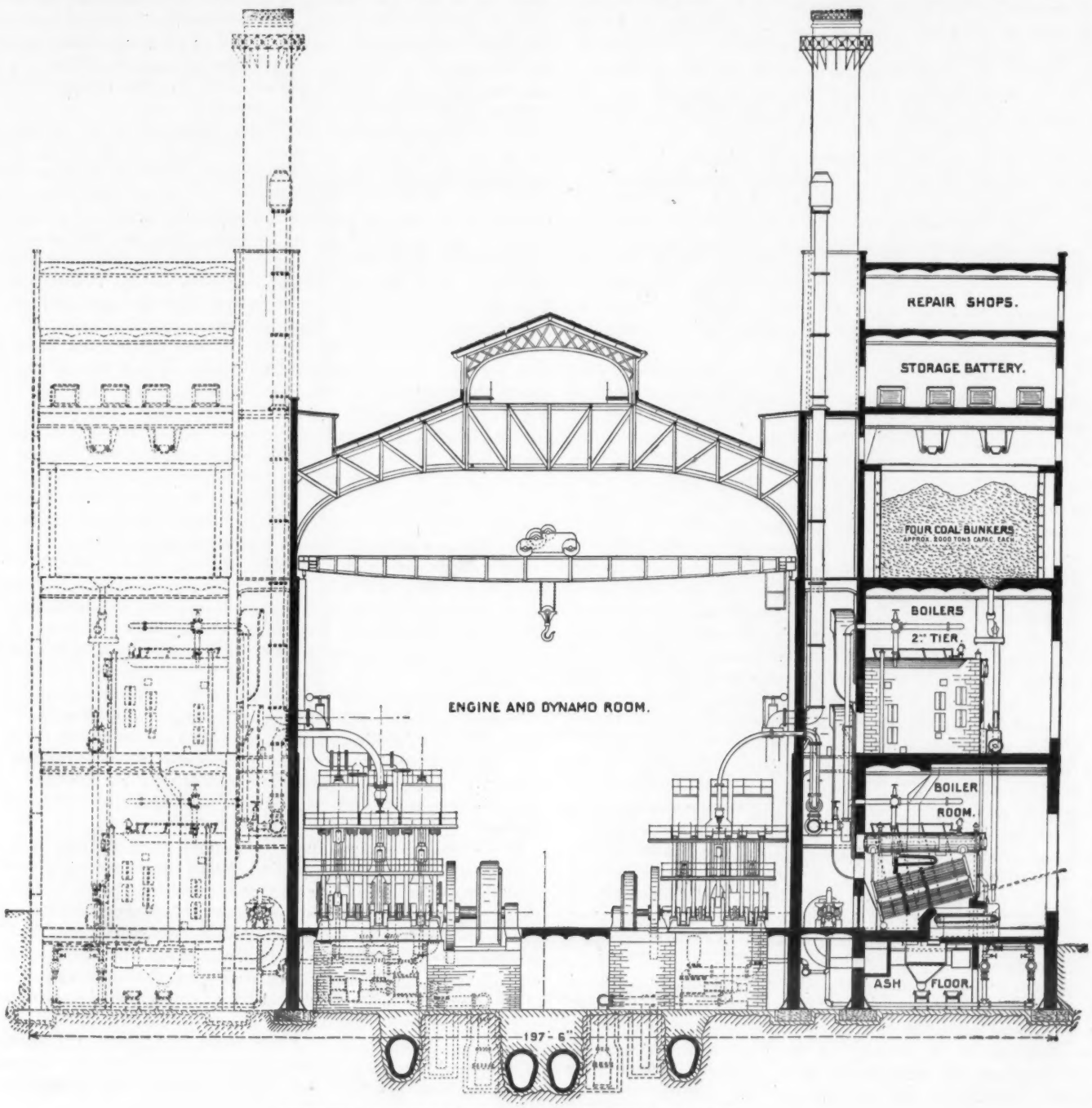
The Growth of Electric Lighting in New York City.



THE annual report for 1898 of the Edison Electric Illuminating Company of New York is a document of unusually interesting character. For mere bulk alone it is striking, running a length of no fewer than 54 pages of about 400 words each, and being supplemented by numerous illustrative plates. Another consideration that gives it importance is the fact that it must be regarded as the last report of First Vice-President R. R. Bowker, who has now resigned irrevocably, after watching over the affairs of the company through a prosperous decade full of remarkable records of advance. Should the new company into whose hands the Edison system in New York passes make a showing of equal gains in its next ten years, those directly interested, as well as the art at large, will have profound cause for congratulation. The changes in administrative management of the company were referred to editorially in the last issue of this journal, and the data now given relate more particularly to the work of the corporation up to date and its plans for the future.

It appears from the report that the gross station earnings were $2,898,021, or a gain of $430,000 over 1897. The net station earnings, after allowing depreciation charges of $210,000, were $1,141,103. Earnings from other sources were $136,000, and the total net income was $1,277,129, or about $160,000 more than in 1897. The interest on bonds was $325,000, while the dividends were $542,743. The increase in earnings was made in despite of a reduction of 15 per cent. in rate, the company continuing to carry into effect its policy of making current cheaper and cheaper. It closed the year with 9990 customers, 443,074 incandescent lamps connected, 7,353 arcs, 24,438 horse-power of motors, or, all installation figures combined, a total of 984,810 lamps of 16 cp equivalent.

Thus for the data in the report of President Trask, which is supplemented, or rather amplified by the report of Vice-President Bowker, in which it is mentioned that during the year 22,777,000 kw hours of current were delivered for consumption; while of the 25,000 horse-power of motors connected, roughly about two-thirds is for passenger and freight elevators and one-third for printing. An investigation as to average revenue shows the return per foot



SECTIONAL ELEVATION FOR WATERSIDE STATION.

of underground main per year in the general business district is $3.50, as compared with $2.50 in the residence districts. The depreciation reserve during the year was 2¼ per cent. on the capital stock, and the amount thus put by was increasing at the rate of $10,000 per year.

But the most interesting and important technical part of Mr. Bowker's report is that which concerns the new stations, two of which, by the courtesy of the company, we are herewith enabled to illustrate, one of them, of the "Annex" type being shown in the initial, while the proposed "waterside" station is shown by diagram. The new "annex" stations, of which there are two, are of the "sleeping partner" description, i. e., do not themselves contain any generating machinery. The one in one cut has 25 feet front and is situated at Elm Street, near Spring, while the other is on East Eighty-third Street, near Park Avenue. Both these stations were planned—on the same general lines—erected, and furnished with storage batteries during the year, for immediate use in connection with the present Edison underground system, the storage batteries receiving current through the tie-feeders from the Edison generating stations during off hours, which current is distributed in the immediate district during the maximum hours through the same tie-feeders made local feeders by the use of disconnective boxes. In each of these annexes the ground floor is a main operating room intended for the installation of rotary converters and static transformers, corresponding to the usual steam operating room; above this is a storage battery room, corresponding to the boiler-room in steam stations, and above this are two sets of comfortable and well-equipped apartments for rental to members of the company's operating force. The facades were designed by the architects, Messrs. Buchman & Deisler, to conform to the general type of Edison stations, as industrial buildings suitable for residence districts.

Before referring to the company's proposed waterside station, incidental reference is necessary to the existing high tension work. The probable demands of the year required that provision should be made for reinforcing the uptown district from the downtown district, and vice versa, pending the development of a waterside station system of supply. The maximum demands in the downtown and in the uptown districts come within the same hour, but at sufficient interval to make desirable an additional supply from downtown, at the extreme maximum uptown, and considerable economy could be effected by transmitting current from the great Duane Street station to the upper district during other hours. Accordingly it was planned to connect the Duane Street and Thirty-ninth street stations by a high-tension cable, through ducts existing along Broadway, and to install at both ends converting apparatus which could be used in either direction, with the additional advantage that in case of emergency at Duane Street station current could be supplied from uptown. There were accordingly installed in the Duane Street operating room two 400-kw and two 200-kw rotary converters, manufactured by the General Electric Company, and at Thirty-ninth Street four 200-kw similar apparatus, all with the requisite auxiliary static transformers, etc. By this plan direct current is taken from the Edison bus bar at the usual voltage, converted from direct current to three-phase current at 80 volts by the rotary converters, raised to high tension by the static transformers, transmitted through the cable to static transformers at the receiving end, which in turn lower the current to 80 volts for use by rotary converters, started by direct current and turning the 80-volt, three-phase current again into direct current of the ordinary Edison voltage for delivery to the receiving bus bar. No change is required in either the rotary converters or the static transformers to enable them to reverse their operation, so that the apparatus at any moment can be reversed at will and current sent northward or southward as demand requires. This cable and the converting apparatus are planned to become a part of the future system of supply by which both the Thirty-ninth Street and Duane Street stations could be supplied, to the full extent of their converter capacity, through the cable installed on Broadway when extended east to the proposed waterside station.

After a trip to Europe of Messrs. John W. Lieb, Jr., general manager; John Van Vleck, constructing engineer, and Arthur Williams, general inspector, coincident with a similar errand on the part of President J. C. Brooks, of the Southwark Foundry & Machine Company, the plans of the new "waterside" station were formulated. Whether it will be built is a question left open by recent changes of ownership of the Edison property, but it constitutes a most interesting piece of advanced central station design, and is clearly set forth in the accompanying plans. They provide for a station approximately 200 feet front on First Avenue, and extending back between Thirty-eighth and Thirty-ninth Streets approximately 400 feet to the East River. They afford place for 90,000 rated horse-power, capable of overload to 135,000 horse-power or even more, in the space stated, with the possibility of extending this to 150,000 rated horse-power, or 225,000 hp overload, should the block be filled in to bulkhead line. The central feature is a main operating room, approximately 100 feet wide and the full length of the block, giving space for two 3000 rated hp (half size) units and fourteen 6000 rated hp units, arranged on either side of the central aisle. These units are of compound, three-crank, vertical engines, built for superheated steam at 500° F. and at 175 to 200 pounds pressure, the large units having each a single three-phase generator, the half-size units having a composite generator producing direct current or at will three-phase current. The condensing apparatus is in close association with the engines, and is supplied by two sets of tunnels communicating directly with the river. The fields of the dynamos can be supplied with direct current either from the half-size generators or from storage batteries, or from the Edison street system, providing trebly against loss of field excitation. The front end of the station affords place for the switchboard and other electrical controlling apparatus and for rotary converters in connection with the half-size units, the front being broken only by a small entrance way for incidental purposes. The main entrance is at the rear, where an electrical crane, traversing the length of the operating room, is planned to lift the largest machine parts either from boats alongside or from trucks reaching it by cartway from Thirty-ninth Street.

The Thirty-eighth and Thirty-ninth Streets fronts are shown occupied by boiler houses approximately 40 feet deep, giving space for sixty Babcock & Wilcox boilers arranged in two tiers, an upper and a lower, each provided with superheating apparatus and automatic stokers. Room is given by the arrangement of the windows for withdrawing tubes from the boilers without sacrifice of ground space for that purpose. The ash-delivery floor is below the boilers, and above them are coal bunkers capable, on the two streets, of holding 8000 tons, and above these are floors for storage batteries and for repair shops and supply rooms.

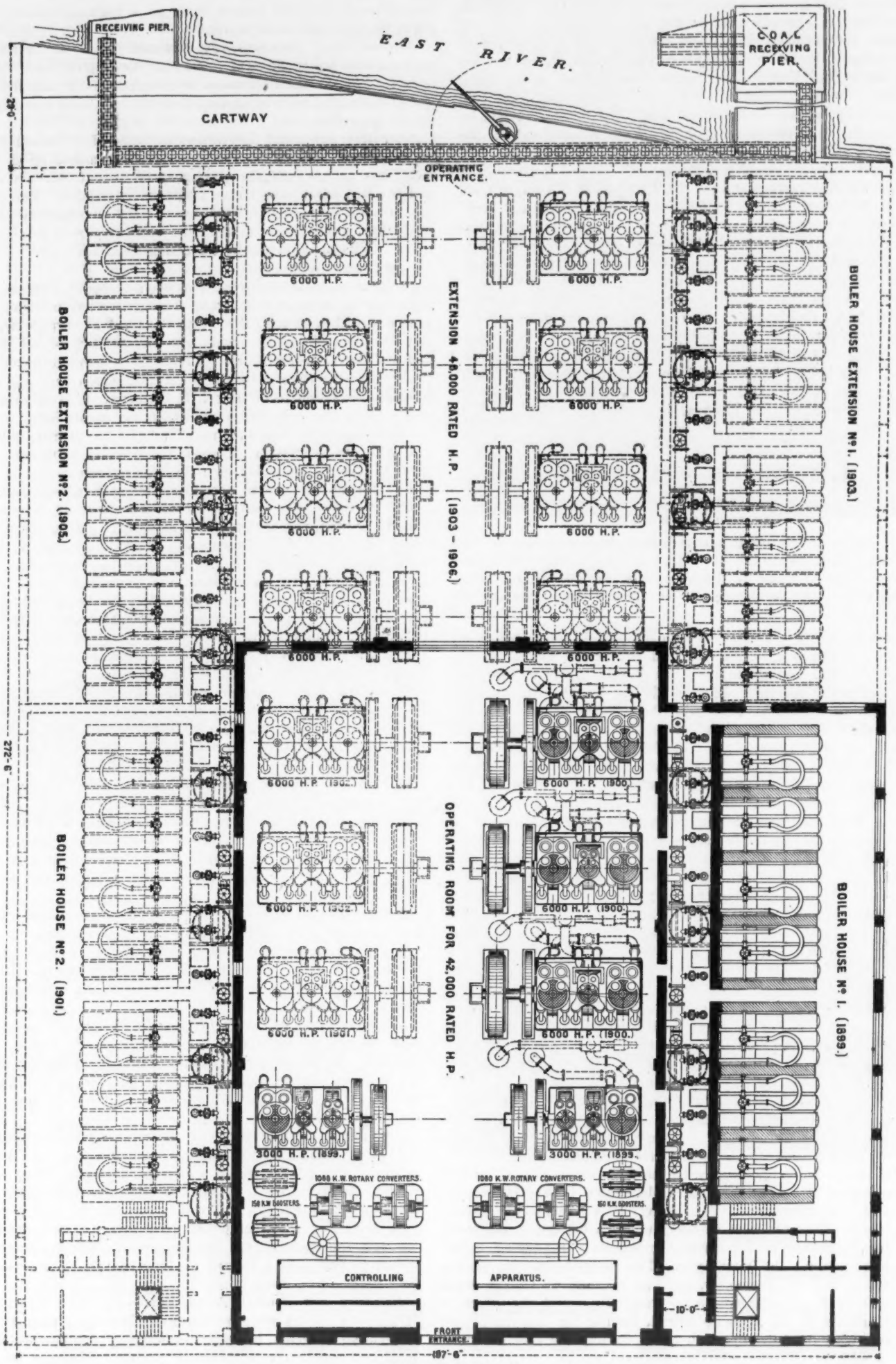
In the 10-foot space separating the operating room from the boiler house, the auxiliary apparatus, the steam piping and the smoke flues are placed, and multiple stacks, one for each group of four boilers, rest on this intermediate structure. Thus there are no lines of steam piping, except cross-over piping and connections to each engine, within the operating room or the boiler houses; the engines and boilers are substantially separated from each other in case of a steam accident on either side; the auxiliary machinery is readily accessible and the multiple stacks avoid possibility of a shut-down in case of accident to a single stack.

With superheating boilers, with engines of an economy of ten pounds of steam to the horse-power, with a minimum distance of steam piping, avoiding condensation losses, and with generators of the highest efficiency, it is believed that current can be produced from such a station at substantially lower cost than in any station yet planned.

The upper portions of the corners on First Avenue, extended into towers, are planned to furnish living apartments for a number of men with their families, in connection with the operating force. It has been proposed to treat the main structure chiefly as an engineering problem, but to make the facade on First Avenue a creditable architectural feature, preserving industrial simplicity of treatment in combination with artistic effect.

The plans, as shown on the diagrams, propose that only the southwest portions of the building should be at first completed, including half the operating room, one out of four boiler houses, and the southern tower. It has been estimated, however, that to keep pace with the growing demands of the Edison system and the high-tension systems affiliated with it, it would be necessary to build a second boiler house in 1901, and to complete the entire station before 1906, when its capacity would bid fair to be required by the demand.

The intention of the Bowker management was that from this station, generating current at 6600 volts, three lines of high-tension cables would be carried—one the line drawn into the Broadway ducts in 1898, another along Third Avenue, and another along



PLAN OF WATERSIDE STATION.

First Avenue, thus providing independent service in case of serious street accident in any one part of the city. The lines, however, would meet for purposes of test and control at the Twelfth Street station, unless it should be preferable to avoid focalizing the several lines at one point. The present high-tension stations of the Manhattan and Harlem companies, at Eightieth Street and East End Avenue and on Twenty-fourth Street near First Avenue, would be superseded by connections through the First Avenue cable; the Eighty-third Street, Fifty-third Street, Thirty-ninth Street and Elm Street annex stations would become centres for the conversion of current to lighting voltage and for the distribution of current from storage batteries; the Duane Street, Twenty-sixth Street and probably Twelfth Street stations would remain as steam generating stations for use during one watch daily through the fall and winter season, and probably be closed during the summer. These arrangements would give to the proposed waterside station a remarkable load line, retaining the advantage of steam machinery at the three points named for supply during the time of maximum demand, thus utilizing machinery of good economy and confining the investment and operating cost of the high-tension transmission lines to normal capacity. It is believed that thus there would be combined also all the advantages of wholesale generation of current, high-tension transmission, and regular low-tension Edison distribution from local centres.

The Wehnelt Electrolytic Interrupter.

BY ELIHU THOMSON.

IN a former article on this new interrupter, published in The Electrical Engineer of March 2, the present writer gave an account of some of his work with this interesting device. He now wishes to add an account of some further observations recently made:

Alternating-Current Circuits.—The interrupter he finds will even work on alternating currents, provided the period natural to the interrupter is high enough to allow the current to rise to the critical value during the half wave or during one alternation. By placing the interrupter in series with the primary of an induction coil and connecting them across the alternating circuit, a torrent of sparks appeared between the secondary terminals at full separation. This was replaced by the noisy arc when the terminals were closer together. Furthermore, the sparks, when obtained, appeared to be undirectional, another good point in favor of the interrupter when used with alternating currents. Hence, there is no obstacle to the use of alternating current in working an induction coil without condensers in exciting Crookes' tubes by the discharges. This fact renders unnecessary the high-frequency apparatus and double-focus tubes commonly used with alternating currents, and reduces the apparatus to a simple induction coil and interrupter. It will probably be best to use a piece of platinum foil as a cathode in place of a lead plate, as this will add to the permanency where the current reverses, as in alternating-current excitation.

Interrupter in Parallel.—It is found that two, three or four of the platinum-point anodes may be worked in parallel in the same acid bath, and that their limiting currents need not be equal, while the sharpness of interruption, even in this case, is not apparently impaired. Several interrupters worked in parallel act as a unit, and take up a rate due to the total current, or, at least approximately, to the sum of the single currents of the interrupters. The musical scale may be sounded by varying the grouping of various sizes of platinum-point anodes properly adjusted.

Inductances.—Interrupters may be made to work with a fraction of an ampere at low or high rates, depending on the inductance in circuit and the voltage. The inductance of the whole circuit, including the dynamo, is to be taken unless a battery, a condenser or a dead-resistance load is across the terminals in addition to the branch containing the interrupter. The presence of the battery in shunt, or of the condenser, if large enough, or of the dead-resistance load, if sufficient, may practically annul the effect of the inductance of the dynamo circuit, leaving the inductance coil in series with the interrupter to alone control the rate of interruption with any given surface of platinum anode.

In one instance two incandescent lamps connected across the mains near the interrupter brightened considerably when the interrupter was working. The rate of interruption was high, and was reflected into the supply leads as a high periodicity superposed on the continuous current.

Different Rates Simultaneously Produced.—Two or more interrupters, working at different rates, may be supplied from the same source. Part of the inductance in circuit may be common to the interrupters, and part be in branches through each interrupter, as before suggested.

Interrupters for Small Currents.—The stem of a discarded incandescent lamp, with its two platinum wires trimmed so as to project 1 mm or less from the glass, may be made to serve as anodes, and the two wires used either singly or in parallel. The currents are in such case small. With quite small interrupters comparatively fine wire may be used in the coils employed in series with them. Coils of No. 30 wire have thus been used, and no limit is yet indicated.

Variation of Inductances.—Several ways of controlling the rate of interruptions may be employed. The writer has used an inductance coil with a switch for varying the turns of wire in circuit and this has been placed in circuit with the primary of an induction coil and its interrupters. In one instance, a small transformer was made with an iron wire bundle for a core, which core was 8 inches long and three-fourths of an inch in diameter. Wound on a bobbin surrounding this core was a coil about 3½ inches long, consisting of eight layers of No. 22 wire. This was the primary put in circuit with the interrupter. Outside the primary turns was a single layer of No. 12, forty-five turns in all, or about 20 feet of wire.

By closing the coarse secondary through a resistance which could be varied, the pitch of interruptions could be controlled, and, if desired, the musical scale sounded. Again, the wire core could be pushed in or drawn from the axis of the coil with the same effect, making this a sort of electrical trombone. Further, numerous taps were taken from the secondary layer, and these enabled more or less of the secondary to be closed, or partly closed through resistances or inductances to secure different rates or pitches. Similarly, in another case the taps were taken from the primary coil, no secondary being used, and the active length varied, which varied the rate. The sounds so produced are not very musical, but are definite enough in pitch to enable a tune to be played, and the device could doubtless be automatically operated by contact made through perforations in a moving paper roll.

Working Incandescent Lamps.—If the coarse wire layer of the coil referred to above be connected to the terminals of incandescent lamps of suitable voltage, they are lighted. Two 20-cp, 25-volt, 3½-ampere lamps were fully lighted in parallel. One lamp being cut out, the brilliancy of the remaining lamp was scarcely affected, showing maintenance of approximately constant potential. The output of the small coil or transformer was tested in other ways, and was found to be astonishing for the size of the coil.

Electric Welding.—A small-sized, open-core welding transformer was operated with entire success, and the same arrangement enlarged and otherwise adapted to the purpose can doubtless be employed on a much larger scale in commercial work. This would enable welding work to be done wherever the direct-current service is to be had.

Efficiency.—The efficiency of transformation will apparently be high enough to make such applications as are pointed out economical. No actual measurements have been made by the writer, for ordinary instruments are not suitable for such high rates of charge as are involved. Resort may, however, be had to calorimetric methods.

New Method of Working.—The writer has tried with success the following method of working an induction coil: A Wehnelt interrupter was put in circuit with an inductance across a 110-volt circuit, direct current. In shunt to the interrupter only, the primary of the induction coil was connected through a condenser. The shunt was not a complete circuit, being discontinuous, except through the capacity of the condenser. The secondary of the induction coil gave a torrent of long sparks. The actions occurring need not be dwelt upon.

Repulsion and Rotation Experiments.—The new interrupter also furnishes a means whereby actions hitherto regarded as requiring alternating currents for their satisfactory demonstration may be produced from direct currents or circuits. The now familiar phenomena of repulsion of rings, plates, or the like, rotations of discs, etc., are readily reproduced. For this one needs only a coil of comparatively small wire wound upon an iron wire core and

an interrupter for small currents, besides a few copper plates, rings, pivoted discs of iron and copper, etc.

Open and Closed Magnetic Circuit Cores.—The cores for the coils used with the interrupter should naturally be of the open-magnetic-circuit type. They may approach the closed-circuit type, having a moderate air gap cut in them. Closed magnetic circuit cores may, however, be employed in the following way, devised by the writer: A polarizing winding, in addition to the other windings, is provided. It magnetizes the core when the interrupter opens the circuit, oppositely to the effect of current in the winding in circuit with the interrupter or primary coil. The relations of turns is such that the current through the interrupter overpowers the polarizing current, the latter reversing the magnetism of the core at the time of interruption. The effect is similar to that of an alternating current in reversing the core magnetism rapidly. If a secondary coil be provided upon the same closed core its turns, sections, etc., can be adapted to the effect desired to be produced.

The Transmission Plant of the Southern California Power Company.

THE completion of the plant of the Southern California Power Company establishes a new standard for heavy long-distance transmission of electric energy, and now that the plant has been in operation for a month, and has encountered the lowest stage of water known in the history of the river and the most trying fogs and snow in the mountains, overcoming all obstacles without serious inconvenience, it would seem to be an opportune time to give a detailed statement of the works.

Transmission Line.

This system for the transmission of power at 33,000 volts a distance of 81 miles, thus surpassing any plant now in operation in these respects utilizes the waters of the Santa Ana River, above Redlands. The company which developed the project is composed to a great extent of the same men who built the Redlands Electric Light and Power Company's plant, Henry Fisher being the president, with H. H. Sinclair as general manager; E. M. Boggs in charge of hydraulic work, and O. M. Ensign as electrical engineer, the latter having many great obstacles to overcome, while the problem of handling the water of the river was no small undertaking. The company later transferred the plant to the Edison Electric Company, of Los Angeles.

The Santa Ana River, like all California streams, is one which varies greatly between the maximum and the minimum flow. It finds its source in the San Bernardino Mountains, which are frequently topped with several feet of snow, and it passes down the mountain side on a grade which averages about 300 feet to the mile, finding its way through a narrow gorge or cañon. About 9 miles above the point where the river leaves the mountains it is joined by the waters of Bear Creek, and immediately above this junction the two cañons broaden out to a considerable distance, while just below the junction the united stream passes between two vertical walls of solid rock more than 200 feet in height, and but little more than that distance apart, thus offering natural opportunities for the construction of a reservoir. While that work is not yet undertaken, it is proposed at this point to erect a steel dam, utilizing the conserved waters for raising the minimum flow of the stream and for irrigation in the valley below, while the dam will also serve for diversion purposes and the reservoir will be utilized as a settling basin.

As yet the diversion of water is by means of a temporary dam, from which the water is carried in a system of flumes and tunnels along the mountain side until a point is reached from which the pressure pipe leads directly down a steep bluff to the power house. The carrying capacity of this system is 15,000 miners' inches. There are eight cement-arched tunnnels in this system, aggregating a length of 11,850 feet, while the flumes of the system aggregate a length of 4150 feet, all the cement used on the system being the product of the Colton, Cal., mines, which is said to have a greater resistance than the imported product.

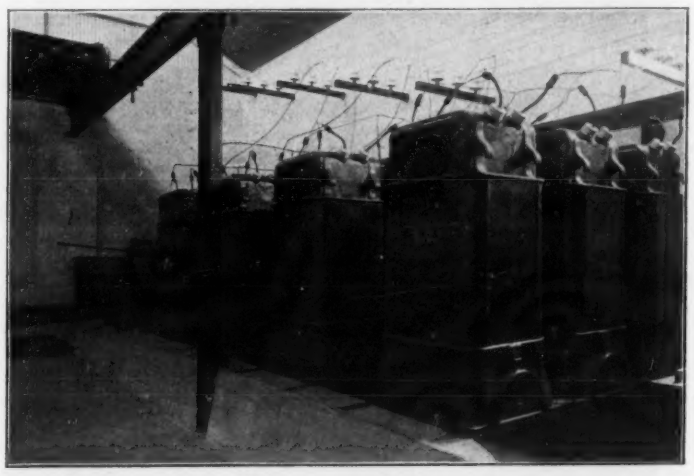
The pressure pipe is 2210 feet long, 30 inches in diameter inside, and at the top begins with No. 10 gauge steel, then increasing to 3-16ths of an inch, and increasing in thickness downward, until the bottom has a thickness of 9-16ths of an inch, the water having a total effective head of 728 feet. The system is designed to have

Two of the Generating Units.

twin pressure pipe, and the other one will be put in in the spring, doubling the capacity of the plant.

These pipes are connected to a 30-inch lap-welded receiver, by means of cast steel flanged tees, 30-inch flanged gate valves being placed between the receiver and pipe lines. The receiver is made in two sections, a 30-inch flanged gate valve being in the centre of the same. The two pipe lines, each with its portion of the receiver, constitute a double system, and the idea of a double system is carried out throughout the plant.

The nozzle for each wheel takes off at right angles to the receiver, passing through the wall of the building under the floor, the bearings of the wheels and generator being low enough to



Step-up Transformers.

allow the water, when deflected, to pass underneath the floor of the building, and discharge into a pool of water outside of the building, the tailraces being lined with steel boiler plate, so that the discharge from wheels cannot injure the tailrace.

The power house is built of concrete, with a sheet-iron roof supported by steel trusses, and is equipped with a 15-ton traveling crane. The machines are ranged along one wall, shafts paralleling the long way of the building.

The water wheels were built by the Pelton Water Wheel Company and are mounted directly on the shafts on the revolving fields of the three-phase generators, each unit being inde-

pendent of the other, each machine being combined as water wheel and generator upon one base Each wheel weighs 12,500 pounds, the centre being made of cast-steel, turned all over to give accurate balancing. The buckets of the wheels are held on by one-inch bolts, driven into turned reamed holes, the buckets themselves being of soft cast-steel. The diameter of the wheels is 82 inches, and that of the nozzle 3¾ inches.

Each generator is of the revolving field type, three-phase, with armature so mounted that it can be moved off the field for repairs without dismantling. The revolving portion of the generator, with its water wheel and shaft, weighs 36,000 pounds, and makes 300 revolutions per minute. At present four generators are in place, and there are foundations for two more.

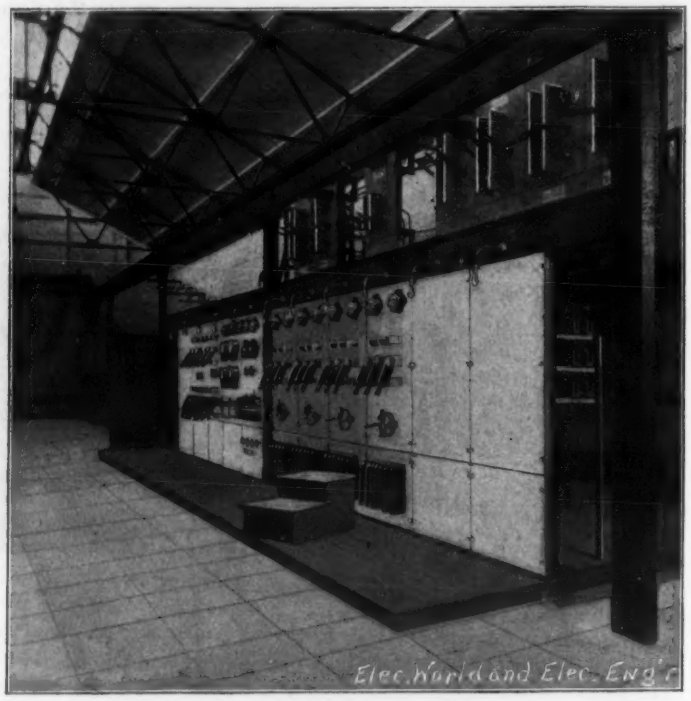
The water wheels are governed by a special Lombard governor, designed for impulse work, and the operation of this governor is declared to be very close to perfect, there having been up to date no test to which it has not proven equal.

The three exciters are of 30-kw capacity each, and each is driven by a separate Pelton wheel, and is governed by a Replogle mechanical governor.

The current generators are of 750 volts, three-phase, and from these the currents are conducted to the transformers, where they are transformed to 33,000 volts for the line. There are now installed 12 transformers in four banks, wound for from 750 to 19,000 volts; each bank of three is grouped into Y formation, giving the required 33,000 volts. The transformers are mounted upon an air duct formed of iron girders and concrete.

The low-tension switchboard is composed of marble panels, 90 inches high, 36 inches wide and 2 inches thick, there being six panels, one for each generator, one for the three exciters, one for the total output, on which is mounted a record-volt meter, a recording ammeter and a recording watt meter on each bus bar. There are three transformer panels for each of the two sets of transfromer switches, so arranged that the transformers can be connected to each set of bus bars. There is a double set of bus bars arranged to run the two complete and separate plants, or with all machines on one bus bar, this arrangement being carried through the exciter bus bars as well.

The high-tension switchboard stands on a gallery above the low tension, and consists of two-line panels, a panel for each of

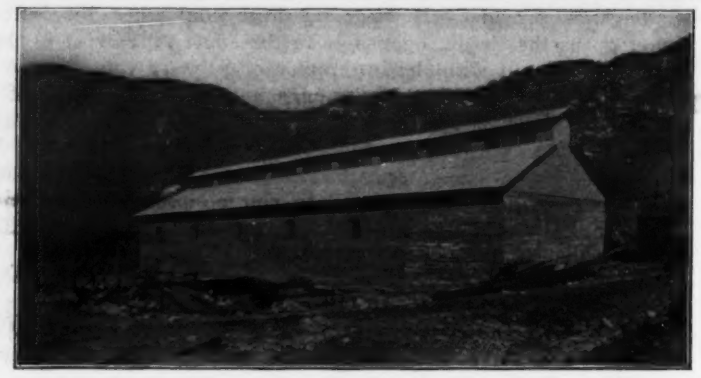


Main Switchboard.

the banks of transformers, there being arrangements for six banks. They are also equipped with double bus bars. The line panels have an ammeter in each leg of the circuit.

The panels are composed of Tennessee marble, the circuits being somewhat insulated from the marble by thick hard rubber bushings, which extend 5 inches through on each side. The marble is all polished on both sides.

The line is 81 miles long, leading from the power house to Los Angeles, there being two circuits of three wires each, the wire being No. 1, B. and S. gauge. In the cañon the poles are 30 feet high, 8 inches on top, 110 feet apart, this portion of the line being 5½ miles long. From the mouth of the cañon to Los Angeles the poles are 120 feet apart, 35 feet high, 8 inches on top. Through cities and towns 50-foot poles are used. The wires form triangles, and are spaced from 17 inches to 28 inches apart. They are spiraled every



Power House.

88 poles on the south side, and every 41 poles on the north side, the two spiralings being so arranged that they will never come upon the same arm. This method seems to have entirely eliminated induction from one circuit to another, or to the Western Union telegraph lines, which parallel the circuit for 71 miles. The company also has a copper telephone loop, No. 12 gauge, on the same poles as the power line, and it is working with perfect satisfaction.

Engineer Ensign naturally counts this overcoming of induction as affecting other circuits as one of the greatest achievements in connection with the building of this great system.

At present the company is supplying power to the station of the Los Angeles Edison Company in Los Angeles, feeding directly their 2200-volt alternating system, from which the electricity is distributed about the city and driving by means of a synchronous motor in their substation the direct-current generators which supply their underground system, and also supplying the Pasadena Electric Light and Power Company's plant for an alternating system of lighting that system and driving the Pasadena company's arc machines by means of induction motors.

As a whole, the plant has entirely realized the expectations of its projectors and engineers, and has been through the severest fogs ever known in this section, as well as heavy snows in the cañon. The fogs are considered the worst elements with which the system has to contend, and yet during them the engineers at the power house were unconscious of any unusual condition, except, it is stated, the charging of the current about 20 per cent. higher than usual, though entirely wattless.

The cost of the system to date has been almost $600,000, and yet there is little doubt that it will prove a fine investment, for the reason that long-term contracts have been entered into which insured success from the start.

Air Power in New York.

It is now stated pretty definitely that ten or twelve street cars operated by air power are to be put on the line of the Twenty-eighth and Twenty-ninth Streets Crosstown Railway in about a month's time. They are to be operated there because the Metropolitan Street Railway Company hopes that air will prove to be more satisfactory than electricity. No arrangements have been made for the operation of air motors on any other city lines.

The amount of misinformation lately published about air power has been excessive. The air-power concerns known locally are three—the American Air Power Company, controlled by Mr. Wilnam C. Whitney and his associates, to operate street cars by that power and to own the Mardie and Judson and other patents; and the International Air Power and New York Auto-Truck companies, which are owned by the Hoadley-Croker-Nixon-McLeod combination, to manufacture air-power machinery and control that trucking business which has lately brought Mr. Croker into collision with the Manhattan Elevated Railway on the point of securing the right to hang supply pipes on the elevated structure.

The Difference Between Good and Bad Incandescent Lamps.

WITH A SHORT ACCOUNT OF THE STANDARD OIL COMPANY'S LAMP TEST.

BY FRANCIS W. WILLCOX.

"WHERE are all the bad people buried?" inquired the child, after reading the epitaphs on her first visit to a cemetery. In like manner we might inquire, Where do all the bad lamps come from? How is the purchaser to determine the good lamps from the bad?

There is no manufacturer of lamps, however inexperienced or limited in facilities, who does not claim to make a better lamp than any on the market. These claims contain about as much truth as the average epitaph; but unlike epitaphs, however, such claims are made before life, never after. With every manufacturer claiming superiority for his lamps, the inquiring purchaser naturally becomes puzzled and needs must adopt some method of separating the good from the bad.

Incandescent lamps are not a mechanical product like chimneys or bottles; they are complicated electrically, chemically and physically, and although they may burn and look alike, they are not by any means alike, either in quality or in results. They cannot be judged, therefore, like tenpenny nails—by the test of cheapness. The cheapest lamps are generally the ones that cost the most in the end, by reason of their inefficiency and frequent failures. Nor is it a definite or satisfactory method to "burn some of the lamps and see how long they will last." This is like trying to determine the area of a plot of ground by taking the length of one side. It leaves efficiency and candle power out of consideration, and gives no definite idea of value.

What method, then, will distinguish between good and bad lamps and discover the best quality; or, in other words, what constitutes lamp quality, and how may it be determined?

There are three things in general that distinguish high-grade from low-grade lamps.

First, freedom from physical defects in the mechanical make-up of the lamps; second, correctness and uniformity in rating of specified candle power and watt consumption at marked voltage; third, degree of maintenance of candle power in service and the uniformity of performance in this respect.

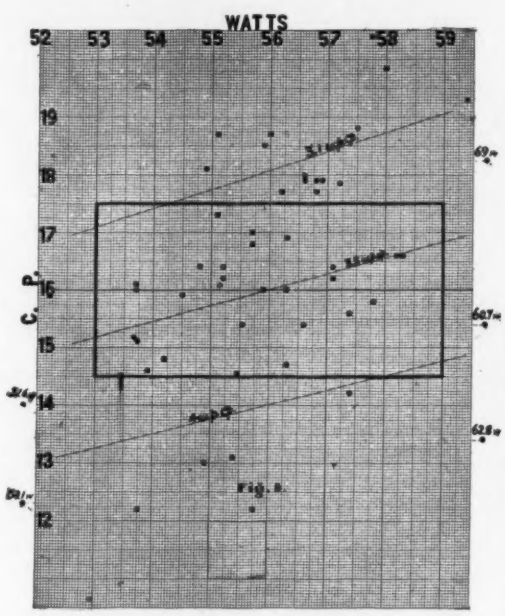


FIG. 1.—SHOTGUN DIAGRAM.
Showing initial candle power and watt readings on 50 16-cp, 56-watt "A" lamps, tested at marked voltage (116 volts). Illustrates lack of uniformity.

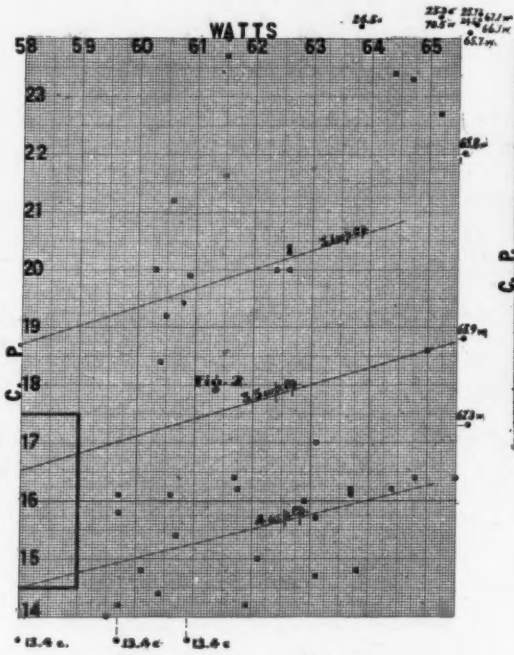


FIG. 2.—SHOTGUN DIAGRAM.
Showing initial candle power and watt readings on 50 16-cp, 56-watt "B" lamps, tested at marked voltage (116 volts). Illustrates incorrect rating and very great lack of uniformity.

PHYSICAL DEFECTS.

The most prominent physical defects are loose caps or bases, bad connections in base, poor vacuum, spotted or discolored carbons. The last defects can be detected by examination of the lamp filaments by light, when they should reveal a clear, smooth, solid, dark gray surface, and by burning filament at a dull red, when it should show up thoroughly uniform and free from any bright or dark spots. No lamps that contain more than 10 per cent. of such defects should be accepted.

CORRECT AND UNIFORM RATING.

As to correct and uniform rating, it is surprising how few makes of lamps will be found to be fully rated in candle power. The "Committee on Standard Candle Power of Incandescent Lamps" of the National Electric Light Association, in its 1898 report, stated as follows regarding the rating of different makes of incandescent lamps:

"From this investigation, the fact stands out that the incandescent lamp sold for 16 candle power is, on the whole, a lamp which is often giving considerably less than its rated candle power, even when new."

Not only are many lamps overrated in candle power; they are also very un-uniform in their candle power and wattage. It is no easy task to furnish all lamps uniformly alike in these two particulars, candle power and wattage. It requires most careful and skilled work in manufacturing, as well as very careful selection after the lamps are made. Correct and uniformly close rating becomes, therefore, a special mark of superior quality, when the average product obtained in the open market is considered, and not specially selected lamps direct from the manufacturer.

Good lamps should measure well within 6 per cent. above or below rated wattage, and 10 per cent. above or below rated candle power at marked voltage.[1]

Fig. 1 shows a graphic method of representing the rating of any make of lamp. The vertical lines indicate total watts per lamp, and horizontal lines the candle power. Drawing the rectangle shown on the limits above specified for good lamps (taking the case of 16-cp 56 watt lamps), we have a target, and its centre the bull's eye, the latter giving the rating point aimed for, and the former the space that good, acceptable lamps should measure within. The diagonal lines shown indicate the efficiency or watts per candle.

The candle power and watts of the individual lamps of each make having been determined by simple photometer and wattmeter readings at marked voltage (the method of testing is described in latter part of this article), these are plotted by dots marking the intersection of the corresponding candle power and wattage lines. In this way a graphic representation of the correctness and closeness of rating in both particulars is given. In Fig. 1 the readings on 50 lamps are plotted, and the diagram shows at a glance the variation in candle power and watts and the non-uniform character of the lamps. The lamps scatter in candle power from 12 to 21 candles, and the watts from 50 to 69. They were ordered and sold for 16 candle power, 3.5 watts[2] per candle—that is, 56-watt lamps. They were purchased in the open market, and represent, therefore, an average product which, it is needless to say, is not good.

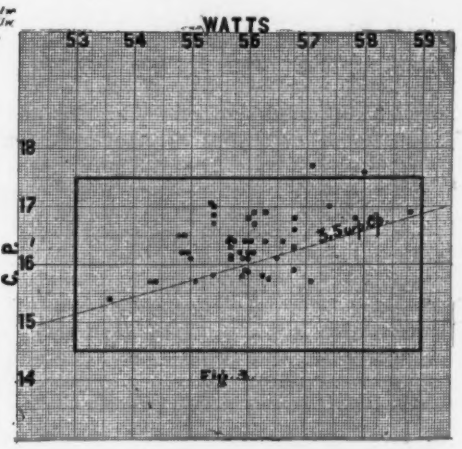


FIG. 3.—SHOTGUN DIAGRAM.
Showing initial candle power and watt readings on 50 16-cp, 56-watt "C" lamps, tested at marked voltage (116 volts). Illustrates correct and uniform rating. All lamps but two fall within rectangle of limits for good lamps.

[1]The specifications recommended by National Electrical Light Association Committee require that "no lamp, when run at its marked voltage, shall show less than 15, or more than 17½, candle power mean horizontal"—testing to be by sample—ten lamps from each barrel.

[2]The efficiency in watts per candle is frequently taken as a measure in testing lamps. As it is a ratio (candle power divided by watts), it does not neces-

Fig. 2 gives the result of tests of fifty lamps of another make. Here the lamps vary so widely from the requirements that in order to show them all it is necessary to place the target so much to one side that only a portion of it is included in the diagram. These lamps fail completely, not a single lamp coming within specifications, as is shown by none striking the target of diagram. They scatter all the way from 13 to 26 candle power, and from 58 watts to 67. These certainly are very bad lamps.

Fig. 3 illustrates the close rating of high-grade lamps, and shows what can be regularly expected of first-class lamps. They were obtained in open market, and represent average results. All the lamps but two are within the target. The average is close to that required in candle power—16½ candle power—and exactly in wattage—56 watts.

To determine true average results in lamps, the average product all lamps decline in candle power after a number of hours of service. It is the relative amount of decline, other things equal, which determines the best lamps.

To make this comparison and determination, candle-power curves are obtained of the different makes of lamps. These curves are plotted from the candle-power readings of the lamps while burning at constant normal voltage, said readings being taken every fifty and one hundred hours. The lamps must all be of the same exact average initial efficiency to produce correct comparative results.

Figs. 4 and 5 show such a candle-power curve. A comparison of the curves of Fig. 4 with those of Fig. 5 readily reveals that the lamps of the latter are much the better lamps. Those of Fig. 4 lose 20 per cent. (to 80 per cent. line) of their candle power in 100 hours, while the lamps of Fig. 5 do not decline this much during

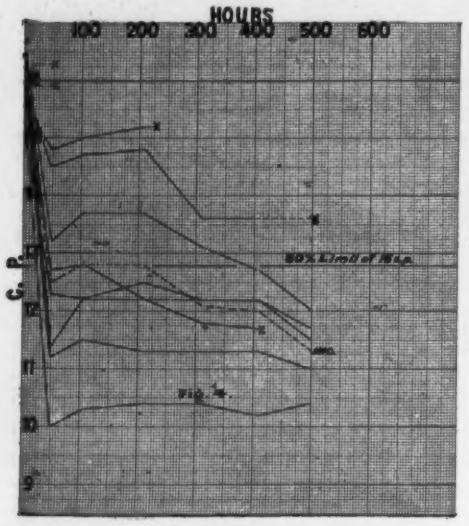


FIG. 4.—CANDLE-POWER CURVES.
Showing decline in candle power of 10 16-cp, 116-volt "D" lamps, tested at average initial efficiency of 3.5 watts per candle at constant voltage. Illustrating rapid decline in candle power of inferior grade lamps, both individually and average; also bad early breakage.

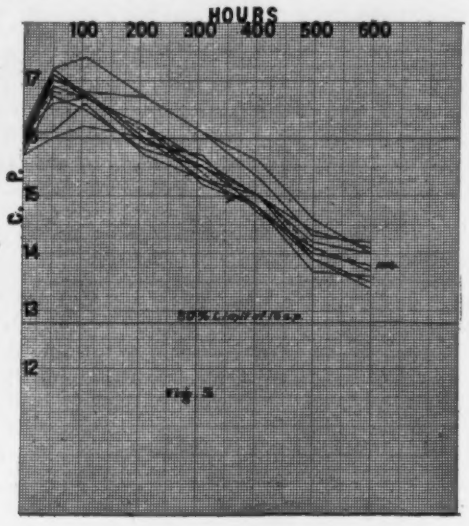


FIG. 5.—CANDLE-POWER CURVES.
Showing decline in candle power of 10 16-cp, 116-volt "C" lamps, tested at average initial efficiency of 3.5 watts per candle at constant voltage. Illustrating the well-maintained candle power performance of high grade lamps, and the uniformity of individual and average results, and absence of breakage.

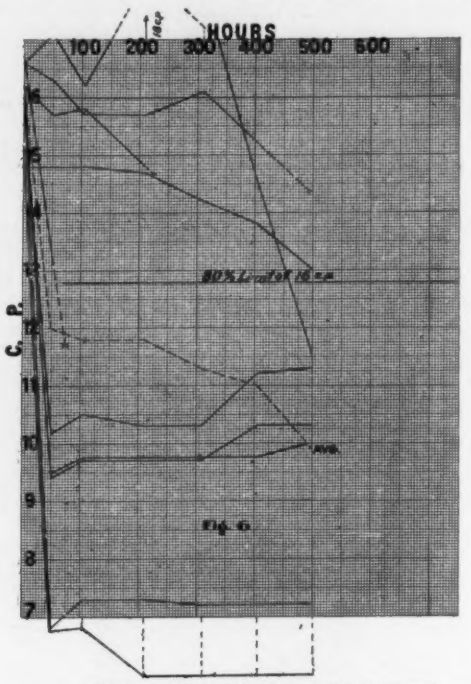


FIG. 6.—CANDLE-POWER CURVES.
Showing decline in candle power of 10 16-cp, 116-volt "B" lamps, tested at average initial efficiency of 3.5 watts per candle at constant voltage. Illustrating bad average performance and very bad lack of uniformity of lamps; also early breakage.

should be obtained by purchase in open market. Avoid sending for sample lamps, or buying direct of the manufacturer, as this results in obtaining specially selected lamps. Results given by the average product as regularly shipped are the true and proper measure—not specially selected lamps, which show what can be done under the stress of special endeavor, impossible to maintain.

Close and correct rating is not only desirable, but it is as essential to good service and best results. This is so for the following reasons:

It produces full and uniform brilliancy, and avoids the marked contrasts so detrimental to good lighting effects which lamps of a wide range in candle power invariably give. It insures uniform consumption and definite and determinate meter bills, and therefore satisfaction of customers. It insures good average life by reason of the uniform initial efficiency of the lamps. This is shown in Fig. 1, where some of the lamps—those in upper part of diagram—are seen to be of a very high efficiency, the one, for example, measuring 24 candle power and 16½ watts giving an efficiency of 2.55 watts per candle, and several others running from 2.5 to 3 watts per candle. Such lamps will have a shorter life than had they been correctly rated in candle power, so as to give the desired efficiency of 3.5 watts.

CANDLE POWER MAINTENANCE.

The real purpose of a lamp is to give light, and the real test of a lamp's value, therefore, is its light-giving qualities. This is determined from the candle-power performance of the lamps—the way in which they maintain their candle power. As is well known, the entire period of test of 600 hours. If the user was to renew his lamps (as is now the best practice) every time they decline in candle power 20 per cent., then he would have to renew the former six times as often as the latter, and they would be worth then less than one-sixth of the price of the latter.

If the lamps were continued in service for a fixed period, or until they broke, as is the custom with some users, then it can readily be shown[2] that the value of the difference in light between lamps of Figs. 4 and 5 for 600 hours is 100 cents, estimating light cost at ¼ cent a lamp hour. If, therefore, the former sold for 20 cents, the latter should sell at $1.20, to cover the value of the additional light given, which is 7000 candle hours.

Fig. 5 is a good illustration of the uniformity of performance of good lamps, the curves all running close together within a spread of one candle only.

An instance of poor lamp quality is shown on Fig. 6. Here we have not only poor maintenance of candle power, but very non-uniform performance, the different lamps scattering about and showing a wide spread of candle power, some good, some bad. Such varied performance causes bad contrasts in lighting effects, and produces complaints more quickly than if the lamps had been uniformly poor, and also produces uncertain and reduced average life.

Fig. 7 is an example of good average result but very non-uniform performance. The individual lamps scatter about, giving results spreading over a difference of 6 candles or 40 per cent. of the lamp-rated candle power.

Fig. 8 illustrates a bad feature in the extreme rise in candle power early in life, and the rapid falling off therefrom. This excess candle

sarily determine correctness or uniformity of either candle power or wattage, since both may be varied considerably and their ratio remain constant. By measuring the candle power and the total watts, however, we get the definite knowledge of each rating, and the efficiency follows therefrom. A further objection to the testing by efficiency is the tendency it gives to determining efficiency by assuming the candle power to be correct and measuring only the watts. This method is a ready and simple one, and therefore frequently adopted, but it is full of error. A 12-cp lamp marked 16 candle power (a difference the eye cannot detect), and taking 50 watts, passes for a 3.1-watt lamp, and yet it is really a 4.1-watt lamp.

[2]See article "The Importance of Quality in Incandescent Lamps," ELECTRICAL WORLD, December 11, 1897.

power is objectionable, as it causes an increase in total watts, disturbs candle-power contrasts, and results in early breakage. Good lamps should run close to their rated candle-power line, not rising too much above or falling too far below it during the limit of useful life.

An examination of Figs. 6 and 7 shows the value of testing a number of lamps (ten or more) instead of only one or two. A test of one or two lamps only might result in such a showing as the top curve of Fig. 6 or the two top curves of Fig. 7; or the other extreme might be obtained. A number of lamps, however, serve to give all the extremes—the best as well as the worst—and thus present a true and safe average.

Consideration of these same sets of curves will explain how many manufacturers mislead themselves and their customers. They test only a small number of lamps, and, obtaining maximum results, such as those shown in the top curves of Figs. 6 and 7, they are led to put forth claims and make guarantees utterly impossible for them to perform.

An old proverb says "A little learning is a dangerous thing," and as applied to lamps it would read, "A little testing is a dangerous thing." With incandescent lamps it is of the utmost necessity to consider only general averages, and not depend on individual results.

The areas included below the candle-power curves, taken to an agreed limit, serve excellently as measures of lamp value. Such areas measure (on a proper scale) the candle hours of light given by the lamp, and are now regularly used to measure and compare the value of different lamps. The limit taken for the area is the 80 per cent. line of candle power; that is, the point at which the candle-power curve declines 20 per cent. in candle power or to 12.8 candle power (in case of a 16-cp lamp). In this method the areas above the 16½-cp line are not counted, which checkmates such lamps as are shown in Fig. 8—that is, having an undue rise in candle power at start. The average candle-power areas of the four makes of lamps here shown are as follows:

Lamp, Fig.	4	1993.	candle hours.
" "	5	8916.	" "
" "	6	2819.	" "
" "	7	7518.	" "
" "	8	4133.	" "

In addition to the three general distinguishing features of good lamps, there are various desirable features which concern more appearance than performance. These are as follows:

Uniformity in size and shape of bulb and of the various parts of the lamp, as well as symmetry in form of filament. Ability of filament to withstand drooping when burned in a horizontal or inclined position.

As to the distribution of light from the filament, the National Electric Light Association has recommended that at 45° inclination no lamp shall give less than 85 per cent. of horizontal requirements.

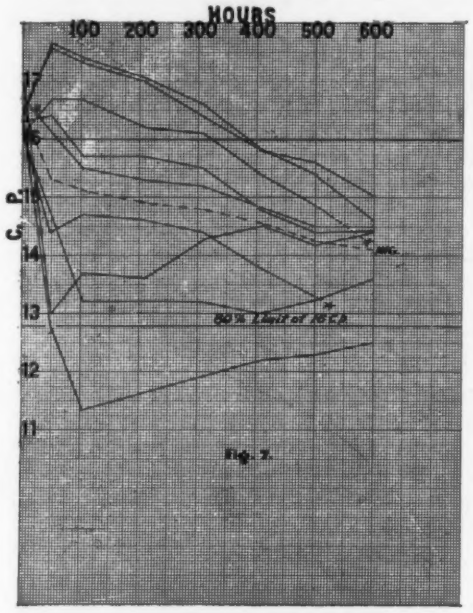


FIG. 7.—CANDLE-POWER CURVES.
Showing decline in candle power of 10 16-cp, 116-volt "E" lamps, tested at average initial efficiency of 3.52 watts per candle at constant voltage. Illustrating very bad and non-uniform individual performance with fair average performance.

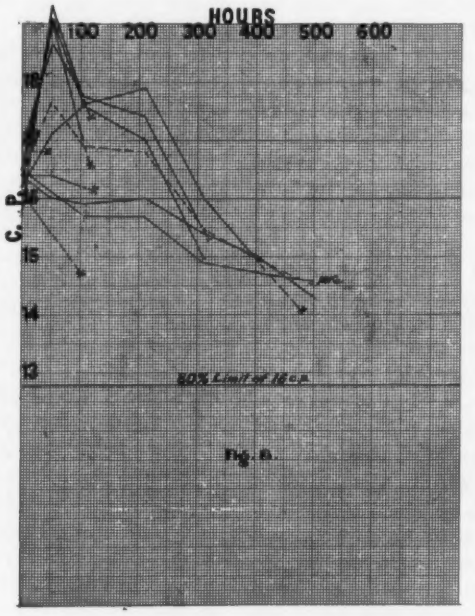


FIG. 8.—CANDLE-POWER CURVES.
Showing decline in candle power of 10 16-cp, 110-volt "F" lamps, tested at average initial efficiency of 3.47 watts per candle at constant voltage. Illustrating bad rise in candle power at start and the consequent early breakage.

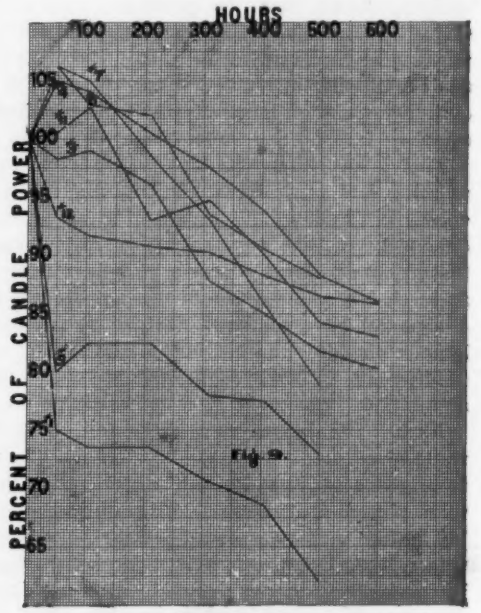


FIG. 9.—AVERAGE CANDLE-POWER CURVES.
Showing average decline in candle power of each make of lamp. Illustrating comparative results.

STANDARD OIL COMPANY'S LAMP TESTS.

As supplementing the foregoing account of quality in lamps, and to describe a practical method of measuring and testing lamps, a short account of a recent competitive test on lamps made by the Standard Oil Company should be valuable and of interest.

In making their test on incandescent lamps the Standard Oil Company carefully observed all the necessary preliminary requirements for a correct and complete competitive test.

First, the purchasing department bought in the open market, unknown to the manufacturers, twelve different makes of lamps. This included all leading makes and insured their obtaining average product, and avoided specially selected lamps. Second, they bought fifty lamps of each make, thus insuring sufficient lamps of each make to give fair average results. Third, they ordered the lamps all of one candle power, efficiency and voltage—16 candle power, 3.5 watts and 116 volts. This insured equality of conditions for the lamps. Fourth, they scratched off the labels and marked each lot of lamps by numbers, the individuals of each lot being numbered from one to fifty; then turned them over to the civil engineer of the company, the purchasing department withholding the names corresponding to the lot numbers. This insured against any personal bias on the part of the testing engineer, and further provided for tabulating results of each individual lamp. Fifth, all lamps were tested in a rotating-stand photometer. This insured very accurate readings in candle power, and gave the mean horizontal candle power of each lamp at every reading. Sixth, correct and reliable instruments were used.

The instruments were:

A Weston direct-current voltmeter, reading to ½ volt; a Weston ammeter, reading to tenths of an ampere; a portable Bunsen photometer of a new type recently put on the market and shown in Fig. 10.

Direct current was used throughout the test, and the watts obtained from the product of the amperes and volts. More accurate results are thus obtained than from wattmeter readings, as ammeters are the more accurate instruments.

The Weston instruments are well known, but a few words describing the portable photometer, not so well known, is desirable. This instrument, in operating order, is illustrated in Fig. 10, which clearly shows its light and simple character. It is of the regular Bunsen grease-spot type, the spot box sliding back and forth on two brass rods. The scale reads direct in candle power, and is made of white celluloid screwed rigidly to the brass frame. An index pointer attached to the spot box slides over the scale. The connection is at the left side of instrument, as shown, and provides

for connections to the line, a voltmeter, a wattmeter, or an ammeter. A small German silver resistance coil with slider provides suitable means for adjusting the voltage.

The accuracy of photometric work is fixed by that of the standards used. If these cannot be accurately set and kept constant and accurate, then accurate work is impossible. Herein lies the special value and unique character of this photometer. Its working standard is a double-burner kerosene oil lamp, shown on the right of the instrument. This is not a primary standard of itself, but is set to the correct brightness by a standard incandescent lamp, placed at the opposite end of the photometer. Standard incandescent lamps form most accurate and reliable primary standards. They are made of any approximate voltage, the exact standardizing voltage being marked to tenths of a volt. Such lamps are seasoned low-efficiency lamps, which, as they are used for only a few minutes at a time, suffer no appreciable change. The oil lamp or the working standard is standardized by checking it with three standard photometer-incandescent lamps provided with the outfit, and held in the dummy sockets, shown near the resistance coil on the left. It is to be specially noted that the primary standard always occupies the same position as the lamp to be tested; therefore tests can be accurately made with this instrument even though the room be not entirely darkened. The oil lamp is provided with adjustable screens that cut off the edges of the flames where flickering is apt to occur.

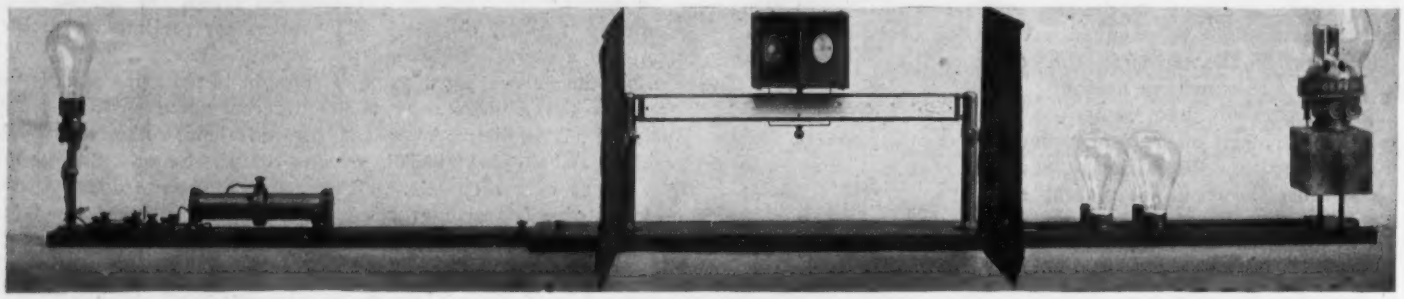


FIG. 10.—PORTABLE PHOTOMETER READY FOR USE.

This oil-working standard was adopted after extensive experimenting had proved it to be thoroughly reliable. It is extremely convenient and satisfactory, as it gives a constant, steady light, independent of the fluctuations of the voltage. Practical trials of these photometers for over a year have proven them to be accurate and reliable, quickly understood and readily operated. They are cheap and have removed the principal difficulty and objection to lamp testing in making photometry simple, easy and interesting.

These preliminary conditions all observed, the test was started and carried out on the lines indicated in the foregoing paragraphs.

First.—The lamps were all tested for initial candle power and wattage readings at marked voltage. The readings of each lamp were noted opposite its number, and then the results of each make were plotted in "shotgun" diagrams arranged as before described.

This initial testing serves like the physical test of the soldier, and rejects unfit applicants and reduces the number of lamps for the remaining test, a very desirable condition, considering the time and attention the remaining tests require. As a result of this initial test four makes of lamps were rejected, leaving only eight makes for further tests. Several shotgun diagrams giving the results obtained by the Standard Oil Company are here produced.

Second.—The test was continued on the remaining lamps for candle-power performance as follows: Ten lamps of each make were picked out of the eight remaining lots, those being selected that were nearest to the candle power and efficiency ordered—that is, to 16 candle power, 3.5 watts per candle, at marked voltage. In this selection preference was given to the watts, so that the different makes would burn as near as possible to the same efficiency, a necessary condition for correct comparative results.

The necessary number of sockets for life tests were so placed that the lamps burned in a horizontal position. Each socket was labeled to correspond with the lamps, so that after the test each lamp would go back into the same socket as before. In this way the filament would be kept in the same horizontal position throughout test, and the drooping tendency would be indicated. The voltage was kept constant and candle-power and ampere readings were taken on each lamp at the end of 50, 105, 210, 310, 405, 500 and 600 hours' steady burning.

From the data thus obtained the candle-power curves of each lot of lamps were plotted on separate sheets, each sheet showing the curves of the ten lamps. From these an average curve from each make was deduced, and the average curves of all the six lamps were then plotted on one sheet. (See Fig. 9.) In a similar way the average watts per candle curves of the six lamps were plotted on one sheet.

From a comparison of the individual curves and of the average curves the best lamp was selected. The deciding points were uniformity of individual candle-power performance and highest average candle-power maintenance. The diagrams of Figs. 4, 5, 6, 7 and 8 give some of the individual results and the average candle-power curves. Fig. 9 shows the average curves of each make under test.

As a result of the tests, the engineer reported that the best lamp was worth 4 cents more than the second best, and 5.82 cents more than the third best, estimating lighting to cost 2½ cents per kw hour (a low figure). The company placed its annual order for 17,000 lamps on the result of the test with the manufacturer of the best lamp.

It is gratifying to be able to record such a test as this. We hope the account and discussion here given will result in such testing methods being generally adopted by all large lamp purchasers. Only in such a way will they be sure of getting at the facts of the case, and it will surely bring more economical results than placing the order with the cheapest bidder, or giving it to the manufacturer who makes the largest number of claims and the biggest statements.

Electrical Things That Are Not What They Seem.

BY ALTON D. ADAMS.

THE advance of electrical science and industry has been accompanied by many illustrations of the fact that "impossibilities" often "come to pass" and justify the beatific dreams of the visionary. On the other hand, electrical history is full of repeated failures to solve problems akin to those of perpetual motion, and is liberally besprinkled with ideas and fallacies that will not down. The exasperating part of the whole business is that just when the electrical engineer should be most emphatic in his denunciation of a chimera he is held back by the haunting fear that he, individually, might be wrong, after all, in his pessimism.

The latest illustration of this condition is found in claims for a new electric generator, recently published in various journals. This generator, it is stated, "will develop current for the same number of lights with the expenditure of only 65 per cent. of the energy required by any other machine." Further light is shed on this remarkable claim by the statement that "this invention is analogous to that of Corliss in the steam-engine field, the result being obtained by using the current expansively, so to speak." The account of the wonderful machine in question goes on to describe a rather complicated arrangement of windings, collector rings and commutators, which, though probably sufficient to "expand" the first cost of an electric generator, does not impress an ordinary designer as likely to have any "expansive" action on the sum total of energy in the universe. Next comes an account of a test, said to have been made with this expansive machine, whose author is careful to state that Weston portable voltmeters were used; but as no mention is made of the important personal element we are left to conclude that the machine was tested by its over sanguine promoters. It is further stated that "the results obtained, while remarkable, can be demon-

strated to be correct theoretically," but this demonstration, for some reason, which must be regarded as unfortunate, is not given.

As is well known, the efficiency or ratio of applied mechanical energy into delivered electrical energy of well-built dynamos in medium and large sizes varies from 90 to 95 per cent. at full load, so that the above claim of ability to operate a given load with "only 65 per cent. of the energy required by any other machine" means that this new, "interrupted-current," expansive generator has an efficiency which may be computed as follows: At 90 per cent. efficiency a dynamo delivers 90 horse-power for every 100 horse-power applied at the pulley, so that a machine to deliver 90 horse-power with "only 65 per cent. of the energy required by any other machine" will take but $100 \times .65 = 65$ horse-power, when delivering 90 horse-power, and its efficiency will, therefore, be $90 \div 65 = 1.38$ or 138 per cent., so that for every 1 horse-power put into such a dynamo 1.38 horse-power may be taken out. Put enough such dynamos in operation, and the fires under every boiler may go out, every water-wheel stop and every other steam engine go to the scrap heap, as by successive transformations through these dynamos and similar motors unlimited power may be had without money and without price..

Let us now look closely at the details of the test. It is stated that two 16-CD, 110-volt, 55-watt lamps, of a standard make were connected, one to an ordinary dynamo, and the other to the "interrupted-current" generator, the lamps being mounted on opposite ends of a photometer and brought to the same candle-power, though it is not stated that any comparison was made with a standard lamp to determine the candle-power of the two, which may, therefore, have been 12, 16, or something else.

It is then stated that the following named powers from engine cards were expended with the stated number of lamps in circuit:

Horse-power from engine cards, 33.35; number of 16-cp. lamps, 304.

Horse-power from engine cards, 13.82, with no load on generator.

No record is furnished of the volts and amperes actually furnished by the "interrupted-current" generator, nor of the watts required by the 304 lamps, said to be of 16 candle-power, but not tested.

The power consumed in lamps and in the windings and care of the generator from the above figures would be $33.35 - 13.82 = 19.53$ horse-power. As the 13.82 horse-power includes the friction loss of the generator, the winding and core loss to be substituted from 19.53 horse-power should not exceed 5 per cent., which is $19.53 \times .05 = .98$ horse-power. Hence, the power actually delivered to the lamps is $19.53 - .98 = 18.55$ horse-power, or, since 746 watts equals 1 horse-power, $18.55 \times 746 = 13838.3$ watts.

The watts per lamp are, therefore, $13838.3 \div 304 = 45$ watts. Now, ordinary 16-cp lamps can be had from any standard maker which require but 50 watts each,, and, if ordered, special 16-cp lamps requiring but 40 watts each can be secured; but they will not last nearly so long as a 50-watt lamp. It is quite possible, therefore, that the lamps in the above test, whose candle power, or watts, was not measured, or at least not reported, actually received but 45 watts each. Suppose, however, that all of the lamps used in this test were 55-watt lamps, or the same as the two first named. Suppose also that each lamp actually gave 16 candle power. Even then there is no reason to think that a method of expanding power indefinitely has been discovered.

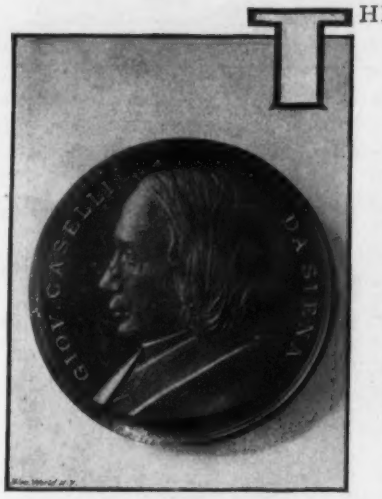
The watts required by an incandescent lamp, in order to give a certain candle-power per watt, depend on the volts at which lamp is operated. Then a 110-volt, 55-watt, 16-cp lamp requires about 3.5 watts per candle power, but if the volts at this lamp be raised to 150 the candle power will increase much faster than the watts consumed; so that the watts per candle power will fall to 2.5, 2, 1.5 or even lower, but the life of the lamp will be very short.

If 100-volt lamps are connected to a 110-volt circuit, the light is increased three or four fold, but their life is so short that the game is not worth the candle. The same result may be attained by connecting lamps to a voltage higher than that at which they are rated, through revolving contacts, so that each lamp is in circuit but part of the time. The life of the lamp, however, is reduced as before. This is an old "will o' the wisp."

Now, this "interrupted-current" generator is alleged to generate 220 volts pressure in each circuit during one-third of the time, and in the experiment given we simply have 110-volt lamps connected to a fluctuating pressure with 220 volts as a maximum. It is to be expected that a smaller power will suffice for a given light, though at a great expense in shortened life of the lamps.

Electricity in the Italian Navy—I.

BY GIULIO MARTINEZ.



THREE years ago I contributed to "The Electrical World" some notes on the application of electricity in the Italian Navy, and, judging from the exhibits at the recent National Exposition at Turin, it is quite time to make some additions to the information therein contained. These exhibits demonstrated very clearly, I think, that the men who are engaged in working out the electrical problems of the navy have pursued a well-defined and logical policy in the course of their improvements.

At the time of my previous article it seemed as if a system had been perfected which would be installed in the new ships without many changes. But for three or four years no large ships of war were added to the splendid fleet of armored vessels of the Re Umberto type, to which I referred in my article, and the progress of development in the application of electricity was brought to a standstill. The Government shipyards have proceeded very slowly with the construction of the two 10,000-ton armored vessels, Amiraglio de Saint Bon and Emanuele Filiberto, and the two armored cruisers of 6800 tons displacement, the Carlo Alberto and the Vettor Pisani. These vessels will be completed during the current year, and the most interesting of them from the electrician's point of view will be the Saint Bon, which is still at the Venice Arsenal.

On the other hand, private shipyards have been very busy, and have sold to foreign powers four cruisers of similar design. Three of these fine ships are of 7200 tons displacement, and were bought by the Argentine Republic; the other has become well known throughout the United States as a participant in the flight of the Spanish admiral from Santiago. It bears a name as dear to the conquerors as to the conquered; the name dear to us Italians also, of Cristobal Colon.

On these four cruisers, intended originally for the Italian navy, many new ideas and improvements were worked out, and the naval authorities, in the meanwhile, were content to observe and take notes of the progress, so that presently they found themselves in a position to apply an entire new system of apparatus. The whole history of this revolution, accomplished in silence, was laid bare to the eyes of the initiated at Turin.

The keynote of this change lies in the multiplicity of electric motors now employed. Not only will the equipments of the new armored vessels like the Saint Bon and the Filiberto comprise a large number of motors, but the older ships also are to receive such a large addition to their motor service that the present system of distribution by special circuits and dynamos will have to be replaced by the switchboard system, enabling both circuits and dynamos to be run in parallel. The distributing boards have therefore been entirely rearranged, and the results have been very satisfactory.

A pressure of 110 volts will be used on all the new ships. The Saint Bon has four sets of 300 amperes capacity and arrangements for a fifth, should it be needed. It is, in fact, difficult to determine just what relations will exist between the actual average and maximum power consumption of the motors and their total capacity.

These changes have entailed others in the electrical equipment and also some permanent additions in apparatus. The aiming of guns by electrical means is now regarded as standard practice.

Latterly, Marconi's system of wireless telegraphy has come into great prominence. The experiments which have been carried on have been kept strictly secret, but from the little that may be stated it is evident that the work of the chief electrician, M. Pasqualini, has accomplished remarkable results. M. Pasqualini conjectured very early that the explanation of the Marconi phenomenon was not to be found in electrical oscillations, and, following out his

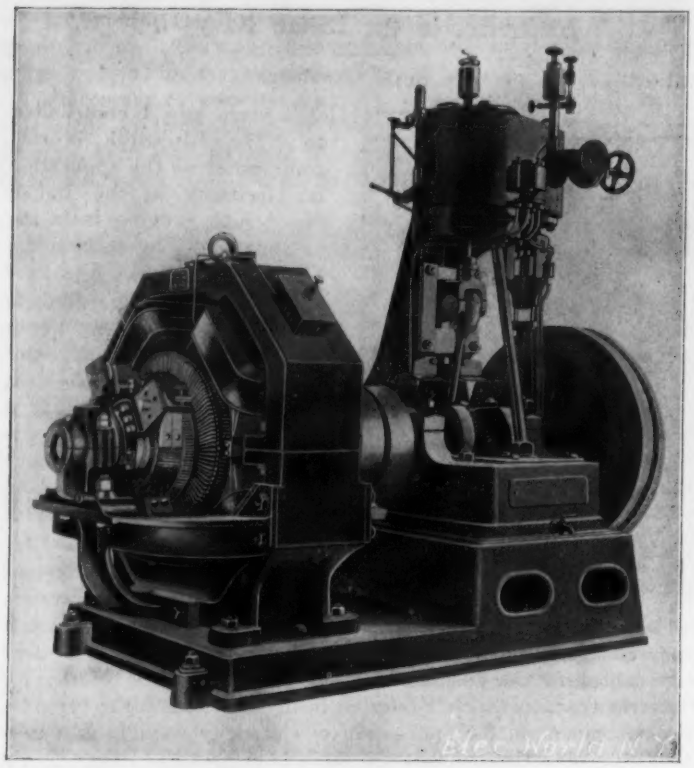


Fig. 1.—Generating Set of the Società Nazionale delle Officine.

idea, which met with strong opposition at first, he was able to simplify extraordinarily Marconi's apparatus, of which scarcely a trace remains.

The practical result obtained is the ability to transmit with certainty over a distance of twenty-four miles with apparatus that requires no attention and which is not erratic like Marconi's, which would often cease to work without any apparent cause and start up again later for no more evident reason.

A description of the new practice may begin logically with the generators. Five or six years ago the Italian manufacturers could not compete with foreign makes, and the Victoria-Brush machine was the type adopted in the navy. But latterly dynamo construction has developed wonderfully in Italy, and in obedience to the policy of having all military supplies made in the country the Victoria type has now been given up and the standard has ceased to be the product of a particular maker, and is simply required to be a four-pole machine, a design which has been the most widely used by our makers. The Tecnomasio, a well-known Milanese factory, furnished the generators for the Argentine cruiser Garibaldi and the Spanish ship Cristobal Colon; the Società Nazionale delle Officine di Savigliano furnished the generators for the General St. Martin and the General Belgrano, both Argentine ships.

This company also builds a machine very similar to the Victoria; it was exhibited at Turin, but the four-pole Brown type is thought to be the better machine. Fig. 1 shows a marine generating set made at Savigliano and having a capacity of 25 horse power at 275 r. p. m.; it is driven by an Odero engine.

But without doubt the machines exhibited by the Società Esercizio Bacini, of Genoa, were a revelation. This firm has got together a very remarkable factory, and it would seem to have been done almost in a day; the heads of the firm seem to be as well informed on electrical matters as they are on the conditions of life on shipboard. It seems that the product of this firm stands the best chance of any of being adopted for the navy, and hence a rather detailed description of it will not be amiss.

The steam-driven generator (Fig. 2) is very attractive on account of its handsome lines and freedom from complications. It is especially designed to operate in very hot and very damp places. The windings are all protected by perforated covers, and nothing is uncovered except the commutator. The brushes, which are carbon and immovable, bear on the upper part of the commutator.

The largest sizes have six poles and the remainder four; the armature is drum-wound, and each winding can be detached without disturbing the others. The excitation is produced by a compound winding, and the field is very intense notwithstanding the large air gap, which minimizes the chances of accident from a slight accidental bending of the armature shaft. At constant speed the variation in voltage never exceeds one per cent.

The firm had on exhibition at Turin four 110-volt direct-current marine generating sets, built for 45, 70, 100 and 150 amperes capacity and 500 r. p. m. respectively, excepting the 150 ampere machine, which ran at 400 r. p. m. They had also a marine type three-phase machine, 450 volts, 25 amp., 400 r. p. m.

The firm of Garg has made some very pretty applications of three-phase currents for the Austrian navy. The subject is receiving some attention in the Italian navy also, but on this point the merchant service has outstripped the navy; I have heard that there are to be some three-phase plants installed on some mail steamers that are building.

Since we are on the subject of alternating currents, we may as well consider next the product of Messrs. Brioschi & Finzi, of Milan, who exhibited some alternating machinery at Turin. This firm furnishes the navy with nearly all its motors, and it will be in line for any work for the navy which may come up when alternating-current applications aboard ship emerge from the experimental stage.

One of Brioschi & Finzi's alternators has peculiarities which make it of interest from the naval point of view. It consists of an external ring built up of sheet iron rings and having internally projecting pole pieces carrying three coils each, two exciting coils with a generating coil sandwiched between them. The rotor is similarly made of sheet iron rings and has externally projecting pole pieces; each pole of the rotor covers two poles of the stator and the e. m. f. is induced by the variations in reluctance of the magnetic circuit, which results when the poles pass one another. This design has some advantages which compensate for its greater cost. The armature reaction is extremely small; this makes the machine relatively light and the efficiency high. Any coil can be removed and replaced without taking the machine apart, and no skilled attendant is required. The magnetic circuit, being entirely laminated, makes it possible to calculate the parts with exactness; the results are found to agree exactly with the calculations, which help greatly in keeping the dimensions of the machine small.

Generators of the marine type are also built by Messrs. Morelli, Franco and Bonamico, of Turin, who do an extensive business for the merchant marine.

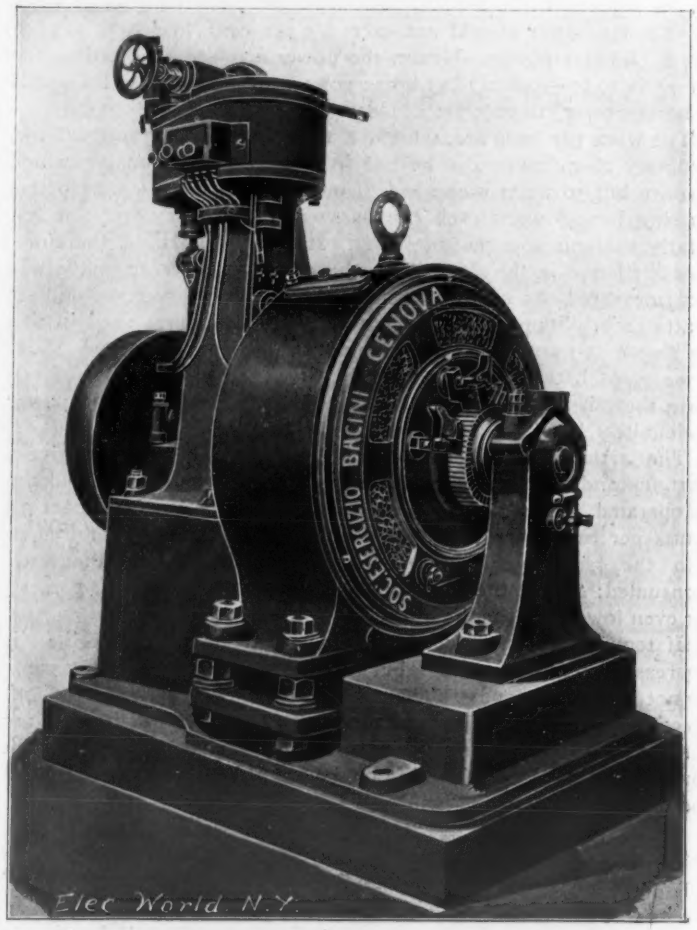


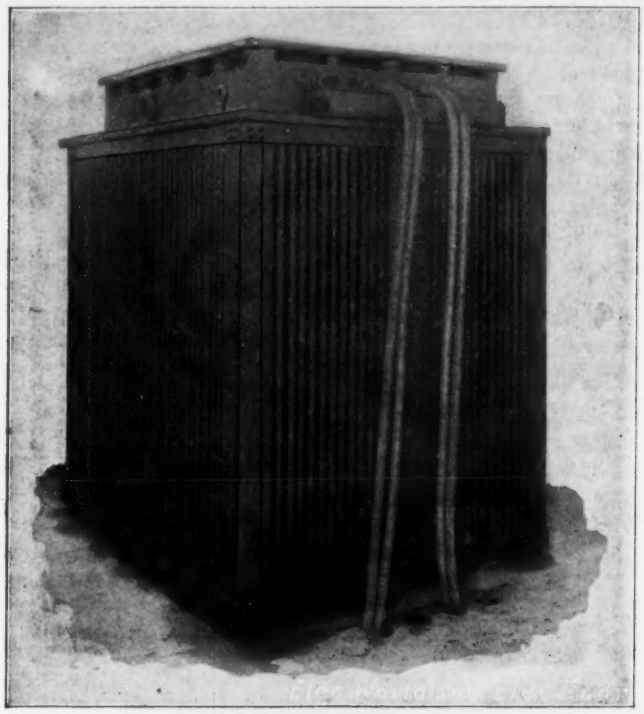
Fig. 2.—Generating Set of the Società Esercizio Bacini.

Tonawanda Transformer Station.

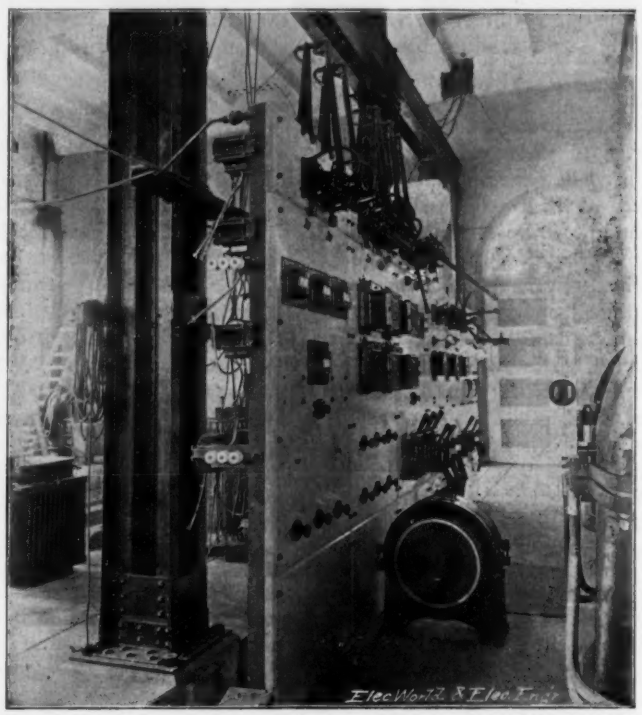
BY ORRIN E. DUNLAP.

AN addition has been made to the electrical plant and service in western New York by the construction in North Tonawanda of a new transformer station, designed to furnish current for commercial purposes in the town of Wheatfield and city of North Tonawanda, Niagara County, and the town of Tonawanda and village of Tonawanda, in Erie County; also for the supply of current to the Buffalo & Niagara Falls electric road and the Buffalo & Lockport electric road, both of which lines since this station has been in operation, have been running exclusively by Niagara power.

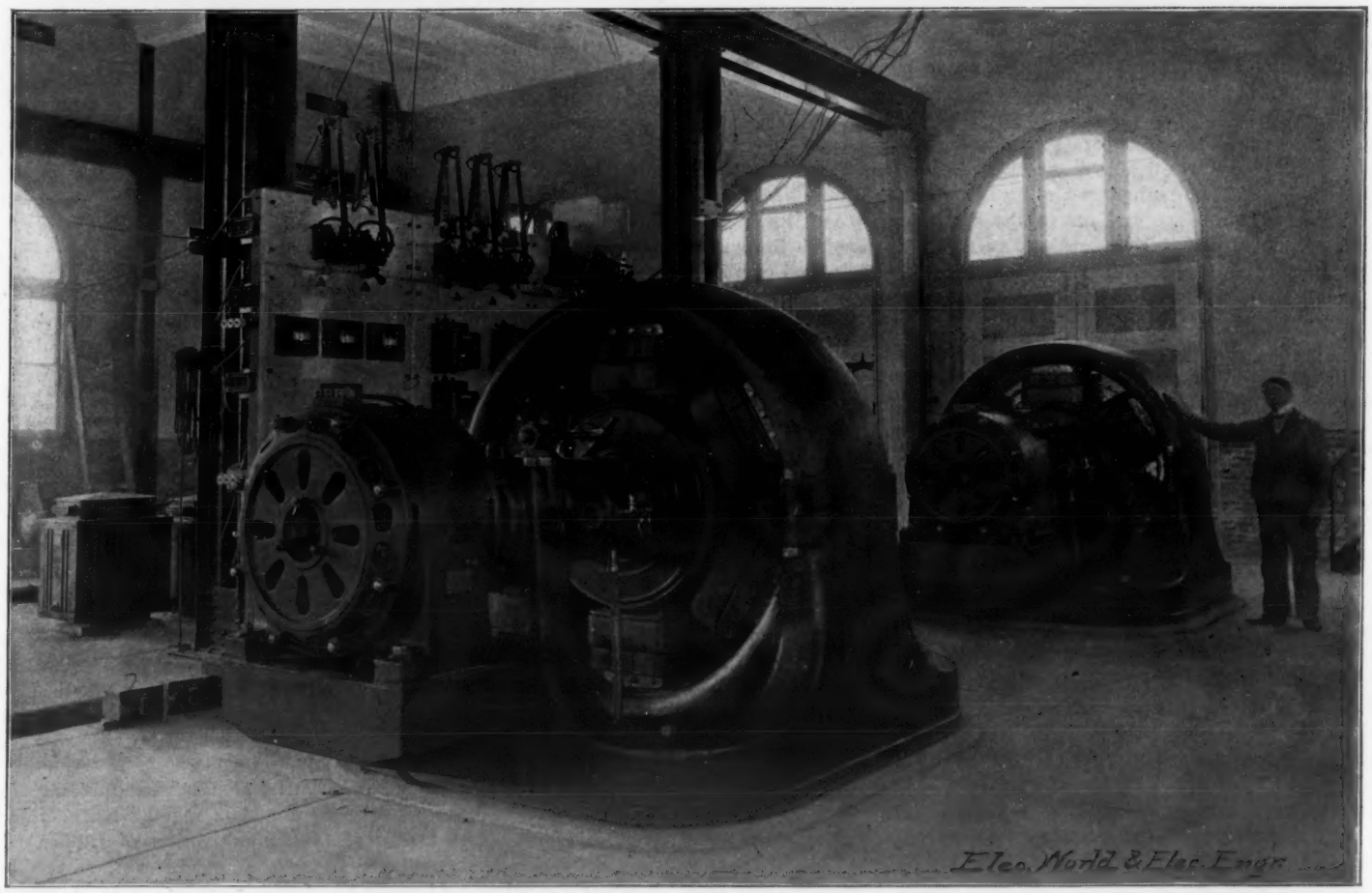
The new station is located on Robinson Street almost beneath the Buffalo-Niagara Falls power transmission line. It is a very fine brick and iron building, 80 feet long by 60 feet wide, and a story and a half in height. The ground floor has been left in a single room, the floor of which is of granolithic pavement. On the east side of this room two 500-hp rotary converters and four 500-hp static transformers have been installed, together with the necessary



ONE OF THE TRANSFORMERS.



SWITCHBOARD.



ROTARY TRANSFORMERS, TONAWANDA STATION.

switchboard. The installation is of Westinghouse manufacture, and ample room has been provided on the same side of the room for two more rotaries. The static transformers are of the oil-cooled type, and the rotaries have small induction motors attached for starting purposes.

The currrent is taken from the Buffalo-Niagara transmission line and enters the building on the east side at a voltage of 11,000, three-phase, alternating. It passes through the high-tension circuit breakers located on the upper floor, and then down to the static transformers, where its voltage is reduced to 375. It is then fed to the rotaries, which convert it for distribution and electric line uses. Alternating or direct current can be supplied from the station. The switchboard has eight panels fitted with the instruments necessary for the control of the various currents. All the panels are of white marble.

From this station current is now supplied to the Buffalo & Lockport road as far east as Pendleton, and to the Buffalo & Niagara Falls road as far north as the car barns, and on the other side to the Buffalo city line. It will be recalled that the Buffalo & Niagara Falls line also is supplied from the Niagara Falls end and the Buffalo & Lockport line from the Lockport end.

The territory in the locality of this new station is most promising for the consumption of Niagara energy. The station and euqipment are the property of the Tonawanda Cataract Power Company, of which Charles A. Sweet, of Buffalo, is president; William B. Rankine, of New York, secretary and treasurer, and De Lancey Rankine, of Buffalo, assistant secretary and treasurer. To the west of the station is situated the great lumber market for which the Tonawandas have become so famous. There are numerous saw mills and other industrial establishments in which the use of Niagara power promises to become an important factor and source of economy and confidence. On one side of the station it is proposed to locate a lighting plant, and this is one of the prospective installations of the future.

Thawing Frozen Water Pipes in Michigan.

BY EDWARD A. BRITTON.

NOTICING the interest being taken in the subject of the application of electricity to thawing frozen water pipes, I send the following information as showing what may be done in that line with simple apparatus.

The apparatus used by myself consisted of a 150-ampere fuse block, a 200-ampere ammeter and a water rheostat. The latter was made in the following manner: An ordinary barrel was about half filled with a solution of water and common salt, the salt being merely put in to increase the conductivity. Then a coil of bare copper wire was dropped into the barrel, forming one terminal of the rheostat. The other terminal was made by fastening a bundle of seven common arc carbons to the end of a piece of line wire. This could be held in the hand and raised or lowered in the solution, thus adjusting the resistance so as to give any desired current.

The current used was taken from a 100-kw, 220-volt, direct-current generator, the connections being made in the following manner:

A tap from one of the main line wires was run directly to a fire hydrant in front of a private dwelling, where the water connection was frozen. A tap from the main line wire was run directly to the copper terminal in the water rheostat. The carbon terminal was then connected to the ammeter, and the ammeter to the fuse block, and from the fuse block a wire was run to the sillcock on the house. The carbon terminal was then lowered into the solution until the ammeter showed a current of 150 amperes, and in about twenty minutes after the current was turned on the water was flowing a full stream from the sillcock.

The house connection was an inch pipe about 40 feet in length, though how much of this was frozen we cannot tell. We next thawed out a line of 80 feet of inch pipe. In this case the fire hydrant, which was connected direct to the main line wire, was at a distance of 100 feet from where the inch pipe tapped off the water main. We used a currrent of 180 amperes for just fourteen minutes, and the water came freely from the two faucets inside the building. This had been frozen for about two weeks, and the owner had spent about $15 trying to get it thawed out.

We next thawed out two house connections at once, the houses being on opposite sides of the street, and connections made to the respective sillcocks of the two houses. With a current of 160 amperes the water came from the first in nine minutes and from the second in thirteen.

Our next attempt brought out a very striking instance of "drop in the zinc." The house, where the connection was frozen, was situated at the end of a pair of No. 6 line wires, 2250 feet in length. In this case we were unable to get a current of more than 125 amperes, no matter how close we held the terminals to the rheostat. We ran the voltage at the generator up to 245 and short circuited the rheostat, thus connecting one main line directly to the fire hydrant in front of the house and the other directly to the sillcock, and then got a current of 130 amperes.

In this case, when we turned on the lamps in the house the filaments did not show even the faintest glow, thus indicating practically a dead short circuit on the line. As the heat loss in the line must equal the energy put into it, or $I^2R = E\,I$, and as the resistance of 4500 feet of No. 6 wire is nearly 1.78 ohms, we have $130^2 \times 1.78 = 245 \times 130$, or $300.82 = 318.5$, which is about as close as one could expect after making allowance for hurried measurements, unreliable instruments and loss in the pipe.

While the method above described was rather crude and not very economical from a commercial standpoint, yet it served the purpose very well. This work was done under the personal supervision of Mr. A. R. Welch, manager of the Chelsea, Mich., plant, assisted by Mr. G. Lighthall, electrician.

CURRENT NEWS AND NOTES.

Prof. F. B. Crocker, of Columbia University, New York, who is now enjoying his "sabbatical year" abroad, was last heard from at Calcutta. He was then on his way across India, and from Bombay proposed to proceed by easy stages to Paris.

Bitter Telephone Fight in Ohio.—A special dispatch from Cleveland of March 11 says: A bitter fight will be instituted at Cleveland on the 15th, when the independent telephone companies will meet to form a combine to make war on the Central Union and Bell Telephone companies. The independent concerns represent a capital stock of $8,000,000.

The African Telegraph.—According to the English newspaper correspondents in Berlin, Emperor William has succumbed to the remarkable personality of the "Maker of Africa," Mr. Cecil Rhodes, and given full consent for the continuation through German East Africa of the telegraph line which is to unite the two extremities of the Dark Continent.

The Slant of the Trolley.—"There's something that bothers me about these under-trolley cars," remarked a rural visitor to the Sportsmen's Show. "If a car is standing still I am momentarily puzzled as to which way it is going to go. We get so used to looking at the slant of the trolley pole for an indication as to the direction that we never think of looking at the fenders in Jersey."

Nickel Steel for Circuit Breakers.—During a discussion at the February meeting of the Société Internationale des Electriciens on fuses and circuit breakers, M. Brunswick directed attention to the adaptability of nickel steel for the latter purpose. M. Guillaume has shown that this material loses its magnetic properties at certain definite temperatures, depending upon the percentage of nickel contained.

Philippine Cable Chess.—Commenting on the victory of the American chess players over the British in the cable games last week, the New York "Sun" says: "Yet some benighted worshippers of an unchangeable past, who have never seen the spark of electricity or absorbed a sense of its capabilities, will have it that it is impossible to make the Philippine Islands into territory of the United States, insisting that they are too far away and too hopelessly beyond connection with our political dominion to be a part of it. Before long a Pacific cable will give to the Philippines the proximity that the British Isles enjoy to the American Union, and the Manila Chess Club will meet the New York Chess Club in battle array, but with the Stars and Stripes waving gayly over all boards."

Rubber Culture in Guatemala.—Consul-General Beaupré, at Guatemala City, has been collecting some data for the State Department of great interest relative to the cultivation of rubber. He has produced statistics alleged to be from reliable authority, showing that the net annual profit from rubber under proper cultivation will be much more remunerative than that which coffee under the most favorable circumstances can yield. The report shows that it

is possible with an outlay of $115,000 to secure an annual profit of $83,000. It is well known the tropical crops often yield large profits, but the risks of failure and loss are correspondingly great.

Unsanitary Trolley Cars.—Mayor Hoos, of Jersey City, N. J., sent a letter to the board of health of that city calling its attention to the condition of the cars of the local trolley lines and to the overcrowding in certain hours of the day. "These human sardine-boxes on wheels," he says, "are fruitful causes of disease. Every passenger is entitled to a seat, but in ninety-nine cases out of a hundred, it is impossible to procure one. . . . I earnestly request that you look into these matters at once." The board promises to act promptly.

Monument to Gaulard.—At the February meeting of the Société Internationale des Electriciens, the president, M. R. V. Picou, stated that the remains of M. Lucien Gaulard, one of the inventors of the alternating-current system, who died ten years ago in poverty, had found a resting place in a "concession provisoire," the term of which was about to expire. In consequence, a movement had been put on foot for the purpose of transferring the remains to a concession in perpetuité, and erecting thereon a monument to the memory of the great inventor. The ground for this purpose has already been secured, and a number of French professional and industrial bodies are securing subscriptions from their members to defray the cost of an appropriate monument.

Power at the Paris Exposition.—Prof. B. D. Woodward, Assistant Commissioner-General United States Commission to the Paris Exposition, said last week that the total amount of power estimated as necessary for the Paris Exposition was 20,000 horse-power, of which about 15,000 will probably be allotted for illuminating purposes and 5,000 for motive power. Practically all the light and power will be electrical. Upon this estimate, there will be allowed a consumption of 440,000 pounds of steam per hour, or, for 205 days at seven hours per day, a total of 631,400,000 pounds of steam for the entire period. This will require 200 tons of coal a day; the water required for condensing purposes is estimated at more than 280,000,000 cubic feet for the whole period of the exposition.

Telephoning When Snowbound.—A special dispatch from Gallatin, Tenn., of March 11 says: J. T. Dunham, attorney, had an appointmen to try a lawsuit at Castilian Springs, 8 miles from here, but the weather was so cold and the snow so deep that he would not make the trip, but remained at home and employed the telephone, through which he conducted the suit. Through his instructions the witnesses were examined, and after all the evidence was in Mr. Dunham made his argument to the court over the telephone. A decision was quickly rendered in his favor.

Telephone War in England.—The Government last week asked the House of Commons for a vote of $10,000,000, in order to wage more active competition with the National Telephone Company, and it is understood that the money will at once be appropriated and spent.

Fire Alarm Record Broken.—The record of fires in the boroughs of Manahttan and the Bronx for a month has been broken again. During the month of February there were 612 alarms of fire. The greatest previous number were received during the preceding month, when 564 alarms made a new record. February had three less days and accomplished it.

Free Trolley Cars for Sunday.—James W. Tapp, a rich merchant and leader of the local Salvation Army, has been nominated by the Democrats of Wichita, Kan., as their candidate for Mayor. Mr. Tapp promises, if elected: $10 fine for any girl wearing bloomers on the street. Any policeman heard swearing will be discharged and all will be required to carry Bibles. Religious services will be held twice daily in the city building. Free street car service will be given on Sunday morning to all churchgoers. Sunday theatres and baseball games will be forbidden. Spitting on the sidewalks will be a finable offense.

An Automobile Ambulance.—Several prominent citizens of Chicago have presented to the Michael Reese Hospital, of that city, an electric ambulance. The vehicle, which was constructed by the Fischer Equipment Company, of Chicago, weighs 1600 pounds, and it can attain a maximum speed of 16 miles an hour. The body of the vehicle is put on a separate set of springs, which reduce the jar and jolting to a minimum. This is said to be the first automobile ambulance ever constructed, and as electric vehicles offer peculiar advantages for this class of service, no doubt ambulances of this kind will become extensively used.

Accumulators vs. Primary Batteries for Telegraphy.—According to a recent statement of Mr. Preece, the well-known English engineer, one accumulator will replace about twenty of the ordinary primary batteries for telegraphic purposes.

Nernst Lamp Company in England.—Mr. James Swinburne, whose lecture on the Nernst lamp was reprinted in THE ELECTRICAL WORLD recently, has been appointed the consulting engineer of the English company.

Charging Automobile Batteries on the Road.—If straws indicate the direction of the wind, the facts recited hereunder certainly point to the development of an electric service that promises to assume extraordinary importance. It may not be generally known, but it is a fact, nevertheless, that all automobile vehicles do not confine their operations entirely within contracted urban limits; some roam about the country at large. A few electric carriages have passed through New Britain, Conn., and have stopped at the station of the Central Railway & Electric Company to charge their batteries. For the accommodation of these vehicles, the company has run a circuit from one of its 110-volt machines to the entrance of the power station. The vehicles are run up to the door, or just inside of the station, where they can be connected with the circuit. The company has not established any regular rates for this service, as the amount of current has thus far been limited. Should the demand increase, however, the company will arrange a basis of charges.

An International District Messenger.—The trip of a 16-year-old district messenger from London to New York, who will arrive this week, is attracting attention, but such things have been done before. Master W. T. Jaggers, "Private 757," of the London service, is carrying some special messages for an American now in the English metropolis, and his trip will, it is said, extend to Chicago, and will take one month. Other attempts of a somewhat similar kind have beeen succeessfully made, notably in 1887, when Daniel Frohman began his management of the New York Lyceum Theatre. At that time he engaged E. H. Sothern to play in a piece called "The Highest Bidder." It was only intended for a short run, but the star and the play made a great success, and it was kept on the boards. Mr. Frohman was young in his career as a manager and Sothern was new as a star, and they felt so elated over their first hit that a souvenir was proposed for the fiftieth night. Mr. Sothern made the drawings himself—a series of sketches typical of the play. Mr. Frohman secured from the superintendent of the American District Telegraph Company one of the most trusted messengers, and dispatched him with a large package of the souvenirs to London, that they might be delivered there to his professional friends, and many of the most important actors and actresses of the English capital; the press and also "Buffalo Bill," who was then giving his first exhibition in England. Buffalo Bill had the entire Wild West Show photographed, with Mr. Frohman's messenger boy in the centre of the group. This picture is still exhibited at the Lyceum Theatre. The messenger boy returned on the same steamer which took him over with the signatures of all the persons who had received the memento of Mr. Sothern's fiftieth night. It was the first time that a messenger boy had been sent upon so long an errand, and many of the newspapers computed the time at so much per hour, and many counted a large financial outlay at the rates named. A special contract, however, had been made with the company. The young man who was sent was Eugene B. Sanger, who has since become an actor of some repute. Another instance is that of a clubman who sent a district messenger from New York to Aiken, S. C., with a costume for private theatricals.

Transmission of Sound by Means of Ultra-Violet Rays.—M. Dussaud has proposed a repetition of the classic experiment of telephony through a beam of light, varying it, however, by using, in place of light rays, ultra-violet rays acting on selenium through a fluorescent substance. The method is as follows: An arc lamp is used to produce ultra-violet rays which are projected as a beam by a set of quartz lenses. This beam passes through two diaphragms exactly alike, and provided with slits. One of these diaphragms is fixed, while the other is movable and connected with a diaphragm

which receives the sound waves to be transmitted. The beam of ultra-violet rays is more or less cut off by the motions of the diaphragm, and consequently illumines the fluorescent screen at the receiver more or less intensely; this effect in turn acts on a selenium plate in circuit with a battery and an ordinary telephone receiver. M. Dussaud was able to transmit sound about 30 feet with this arrangement.

The Submarine Cable Industry of France.—Considerable additions are about to be made to the Venezuela submarine cable system, owned by the French Telegraphic Cable Company. At present this system comprises the cables running from Guayra to Puerto Cabello, Guayra to Carenero, and from Vela de Coro to Curaçao. The French Telegraphic Cable Company has ordered from the Telephonic Industrial Company nearly 250 miles of cable to connect Vela de Coro with Maracaibo. This will leave still connections to be laid down between Carenero and Guanta, Guanta and Cumana and Cumana and Carupano. This is good evidence of the healthy growth of the French cable industry. Such work has fostered the growth of cable manufacture in France; it was long a monopoly of England, but now is meeting with success in France at the hands of the Telephonic Industrial Company, which recently manufactured and laid a transatlantic cable from New York to Brest.

Talked Over a Wire Fence.—The wire of a telephone line between Flora and Camden was broken by contraction caused by the cold weather and fell to the ground. A passer-by threw the ends of the wire over a wire fence, so that teams might not get tangled in it. It so happened that both wires lay on the top strand of the wire fence, but about 50 feet apart. The telephone worked as well as before, and the patrons were unconscious of the fact that they were talking partially over a wire fence.

The New Indianapolis Street Railway Company.—The reorganization of the Citizens' and City Street Railway companies has been accomplished, and the new company will be known as the Indianapolis Street Railway Company. The capital is placed at $2,000,000. The election of officers has taken place, and a prominent merchant named H. P. Wasson has been chosen president. The company will appear before the Board of Public Works and submit a proposal for a new contract or franchise along the lines of the new law. It promises sweeping improvements, but the citizens generally are demanding a straight 3-cent fare, with transfer privileges. The question has aroused much interest, mass meetings have been held and resolutions passed declaratory of the wishes of the people.

Automobiles and X-Rays.—A physician in New York recently wished to apply Roentgen rays in the case of a patient with a fractured arm, but no source of current was available in the residence of the injured person. A happy thought occurred, and shortly after an electric cab was at the door, a connection was made from the cab battery to the physician's inductive coil, the rays applied in the patient's room, and the injury promptly located.

Nernst Lamps at the Franklin Institute.—The regular stated meeting of the electrical section of the Franklin Institute, Philadelphia, was held on Tuesday evening, February 28, with Prof. Geo. A. Hoadley in the chair. Prof. Franklin, of Lehigh University, explained several new laboratory experiments that he has introduced with marked success in his class-room work. He also showed a new type of lamp made by himself, on the same principle as that invented by Prof. Nernst, of Goettingen University. The lamps shown were glass tubes about 2 inches long by one-quarter inch wide, filled with magnesium mixed with powdered glass, a platinum terminal contact being sealed in each end of the tube. In his experiments with these lamps he has secured a very satisfactory light. The topic was discussed by Messrs. Reed, Stine and others. Mr. Carl Hering brought to the notice of the section the remarkable properties of the Wehnelt interrupter, whose details have already been made familiar to the readers of this journal.

Electrical Transmission Plant in Mexico.—A concession has been granted to Quintin Gomez y Conde and Leopoldo Gavito for the construction of the necessary works to enable them to utilize part of the waters of the Atoyac River. They propose to install a large electric power transmission plant. Under the terms of the concession the surveying must begin within four months and the construction work two months after the approval of the plans by the government.

Electrical Progress in France.—On January 1, 1897, France had 180 miles of electric lines, with an aggregate power of 12,000 horse-power. One year later, in January, 1898, the aggregate power in operation had reached 25,000 horse-power and thirteen new systems, amounting to 8000 horse-power, were under construction. At the same date Germany had 40,000 horse-power. The number of lighting stations is rapidly increasing; a rough estimate of their present capacity puts it at 100,000 horse-power, while the total power used in plants of all kinds is about 256,000 horse-power. Incandescent lamps which sold for $1.40 each in 1885 are to be had now for 14 cents. Storage batteries are not behindhand in the race. The Tudor Company alone uses 4000 tons of lead a year. A new life has been infused into the study of electricity in France by the formation of an advanced school of electricity by M. Mascart, of the Institute, and M. Janet, assisted by a competent corps of professors. Each year between fifty and sixty electrical engineers graduate from the school in the Rue Staël and carry over the country the knowledge gained from a remarkable course of study. France is in the front rank as regards traction by electric locomotives and electric automobile work, as she has been with respect to the electric furnace, owing to the efforts of M. Moissan.

To Control the Mica Supply.—A dispatch from Norway, Me., states that the formation of a syndicate is under way there for the purpose of controlling the mica supply of the world. The right to mine in about 15,000 acres of this country has been granted. The right covers, it is asserted, all the places known where mica can be produced profitably.

Over Seven Hundred Residents of Amsterdam Avenue, Manhattan Borough, New York city, went to Albany on March 9 to urge the favorable consideration by the Legislature of the bill introduced in the Senate and Assembly to compel the Third Avenue and Metropolitan Street Railway companies to use one set of double tracks on Amsterdam Avenue, between Seventy-second and 125th streets, for the operation of their cars. It required eleven cars to convey the delegation to Albany. The visitors marched in a body to the Capitol. The delegation was the most numerous that has appeared in Albany in many years on such a mission.

Telephone Service for All.—President Charles J. Glidden, of the Erie Telephone Company, while in Cleveland recently, in attendance at a special meeting of the directors of the Cleveland Telephone Company, stated that the directors of the Cleveland exchange had for some time been considering the introduction of a service that would place the telephone within the reach of the $75 clerk as well as the large manufacturer and mercantile establishment. He believed that the problem had been solved in the introduction of the 5-cent daily guarantee service, with no charge for inward calls, as well as the one-way service. The cheap service, he stated, is becoming exceedingly popular, and the number of subscribers in the Cleveland exchange would increase at the rate of 1000 monthly. It is proposed to continue canvassing in Cleveland until 16,000 subscribers are secured. In order to conduct this service properly the company will purchase land and erect four new branch exchanges in different sections of the city.

Convention of Railway Telegraph Superintendents.—The Association of Railway Telegraph Superintendents will hold its next annual meeting in Wilmington, N. C., on May 17 next.

State League of City Officials.—The League of Illinois Municipalities was duly organized at Peoria, Ill., on March 1, when a constitution was adopted. According to this instrument the objects of the organization are a practical study of all questions pertaining to municipal government and administration, and the holding of annual conventions for the discussion of these questions and the interchange of information derived from experience. The league is to promote such State and municipal legislation as shall be best calculated to advance the general welfare of cities. After the routine business was disposed of Mr. Allen R. Foote, of Washington, D. C., read a paper on "How Shall the Franchise Question Be Settled?"

Power Transmission in the State of Washington.—The Washington Power Transmission Company, which was recently incorporated under the laws of the State of New Jersey, has a capital stock of $1,250,000, and was formed for the purpose of developing electric

and hydraulic power at the falls of Cedar River, 35 miles from Seattle, Wash. Much speculation has been indulged in concerning the company's plans, but it is known that Frank L. Dame, superintendent of the Tacoma Railway Company, in Tacoma, Wash., is authorized to make contracts for electric power to be furnished in Tacoma not later than October 1, 1899. Seattle and other places will also be supplied from the same source. It is understood that the consolidated street railways of Tacoma are to use a large part of the current from Cedar River, and the surplus will be sold at low rates for light and power purposes. Bids have been asked for poles, and the machinery has been ordered, it is said. It will probably be a General Electric system.

Combination of Central Station Companies in New Jersey.—The United Electric Company of New Jersey was incorporated at Trenton on March 4, with a capitalization in stock of $20,000,000. It is stated that the object of the company is to unite and control all of the electric light, heat and power companies in Essex, Hudson, Passaic, Bergen, Morris, Union and Middlesex counties. Bonds will be issued to the amount of $17,500,000, to be used in the payment for the companies absorbed and for extensions and improvements in existing plants. The incorporators are F. M. Stillman, of Rahway; W. J. Davis, of Harrison, and Thomas J. George, of Newark. The United Gas Improvement Company is reported to be a prominent factor in the new corporation. The People's Light, Heat & Power Company, of Newark, which controls all the plants in Essex County and many in Hudson County, will be included in the new combination.

The Telephone Transmitter in a Vacuum Again.—The placing of microphone contacts in a vacuum or in an inert gas has, according to the London "Electrician," given greatly improved results in an instrument devised by Mr. Paul Kilduchevsky. The greatest improvement is in the power that may be applied to the contacts, a granular button form having been used with seven cells of storage battery in series, giving a current off from zero to 9 amperes in the microphone circuit without impairing the articulation. It will be remembered that a similar modification has been devised in this country by Mr. John Stone for telephonic repeaters, an account of which appeared in "The Electrical World" of October 1.

Exports of Electrical Material from New York.—The following exports of electrical material were made from the port of New York for the week ending March 7: Antwerp, 41 cases electrical material, $3357; Alexandria, 38 cases electrical machinery, $9893; Bremen, 2 cases electrical material, $174; British Possessions in Africa, 5 packages electrical material, $194; British West Indies, 43 packages electrical material, $460; Berlin, 10 packages electrical material, $340; Brazil, 69 packages electrical material, $3210; British Australasia, 11 packages electrical material, $3000; Chili, 7 cases electrical material, $53; Central America, 21 cases electrical material, $466; Christiania, 65 packages electrical material, $1272; Ecuador, 1 case electrical material, $26; Hull, 4 packages electrical material, $50; Liverpool, 21 packages electrical material, $1105; Mexico, 83 packages electrical material, $2066; Porto Rico, 3 cases electrical material, $18; Southampton, 8 cases electrical machinery, $155; United States of Colombia, 5 cases electrical material, $141: Venezuela, 69 cases electrical material, $533.

LETTER TO THE EDITOR.

Thawing Frozen House Mains.

To the Editor of Electrical World and Electrical Engineer:

In connection with the thawing of house mains, which has recently been mentioned in your columns, data concerning the thawing of a 4-inch water main by the writers may be of interest. Such a main, weighing 19¼ pounds per foot, was frozen on the campus of Cornell University. Attachment was made in the dynamo laboratory and in the chemical building, the current being carried directly from a 220-volt, 60-cycle alternator by a No. 2 copper wire. The length of the main was about 100 feet. A current of 160 amperes was maintained for five hours and forty minutes before the pipe opened up. This required a pressure of 12 volts at the generator, with 3 volts drop in the leads, there being 9 volts at the water pipe. The power used in thawing the pipe was accordingly 1440 watts, or about 2 horse-power. Just before the opening of the pipe it was heard to growl with the moving ice, which was ground up at an elbow, and almost immediately the water began to flow.

FREDERICK BEDELL.
GEO. S. MOLER.

ITHACA, N. Y.

DIGEST
OF
Current Electrical Literature.

BY CARL HERING.

Dynamos, Motors and Transformers.

Rotary Converter with Variable Voltage.—In a previous article Mr. de Marchena (see "Digest," Sept. 3, 24, Oct. 22) discussed the general principles of the action of such converters by assuming that the voltage at the terminals remains constant for different loads. In a supplementary article in "L'Ind. Elec.," Feb. 10, he discusses analytically the case in which the voltage should vary with the load, as frequently required in practice. There are two cases, one in which the voltage should diminish with an increased load, and the other in which it should increase with the load; in the former case the simple shunt or separate excitation should be used, while in the latter it is necessary to add a series winding, combined or not with the shunt or separate excitation. In his discussion he endeavors to determine the best conditions for these two cases.—de Marchena. "L'Ind. Elec.," Feb. 10.

REFERENCES.

Commutation in Dynamos.—The conclusion of the long analytical article noticed in the "Digest" March 4. No definite conclusions seem to be drawn, and the article does not admit of being abstracted. It is largely theoretical in character, and contains numerous formulas for use in such calculations.—Arnold and Mie. "Elek. Zeit.," Feb. 23.

Compound Alternators.—In the "Digest," Feb. 4, Mr. Danielson describes a method of compounding an alternator. Professor Blondel now states that he described the same method at the congress in Geneva in 1896, and showed it to some one as early as 1894. —"Elek. Zeit.," Feb. 16.

Continuous-Current Dynamos.—Brief, illustrated descriptions of various improvements described in patent specifications.—Guilbert. "L'Eclairage Elec.," Feb. 25.

Lights and Lighting.

THE NERNST LAMP.

Some forerunners of the Nernst lamp are described in the Lond. "Elec. Rev.," Feb. 24. Le Roux, a French professor, discovered that a brilliant incandescent light was obtained from a rod of lime by heating it until an electric current passes through it. His discovery may have been accidental, and was merely a laboratory experiment. In "Comptes Rendus," Vol. 66 (1868), p. 1151, he states that if a cylinder of magnesia is pressed against the carbons of an arc lamp so as to shunt the arc, and so held there by a light spring, the quantity of light emitted was largely increased. The whole, or greater part, of the current was found to have been shunted through the magnesia when its temperature had been sufficiently raised. In suggesting an explanation of this phenomenon he states: "Is it an electro-chemical decomposition exercised upon the conductor, which has become a conductor owing to the rise of its temperature?" The next important worker in that field seems to have been Jablochkoff, who observed that the incandescence of the kaolin between the carbons of his well-known candle contributed perceptibly to the amount of light. In 1877 (Eng. Pat. 1996) he patented a

lamp in which the incandescent body was a slab of porcelain, although he claims refractory materials in general in his patent. The illustration from this patent is reproduced in that journal, and a portion of the patent is quoted. The illustration shows a short, horizontal rod between two clamps, which are connected with the secondary of a transformer. He states that the current is first made to act upon a kind of conducting match which is placed on the edge of the slab, and the latter is thereby heated until it starts to conduct, after which the current heats it to a white heat. There is a certain consumption of the kaolin, but it is said to be very small. A thin layer of carbon powder and treacle appears to have been used for the igniting. Mr. Hardy states that he saw the lamp in use at an electrical exhibition in London in 1879. The illustration of a Nernst lamp from the patent specification is reproduced, together with extracts from the main patent and from a later one, in which he states that with certain mixtures the conducting power rises considerably more rapidly with the increase of temperature than it does with the magnesia, which can be brought to incandescence only with some difficulty; if, however, only a small percentage of boric acid, calcium chloride or tungstic acid is mixed with it the conducting power is increased to such an extent by heating that 100 volts are sufficient to start the current when the rod is warmed with only a light flame, such as that of a match. From this later patent it seems that he has abandoned the use of magnesia, giving preference to a mixture of oxides such as are used in the Welsbach mantle. Another early lamp of his kind is what was known as the "lampe soleil," which was in use some twenty years ago. This was a sort of a combination of the arc and the electrolytic lamp, being probably mainly the latter, the arc simply acting as a preliminary heater. In this lamp an arc was formed in or just below a slab of marble.—Lond. "Elec. Rev.," Feb. 24.

In another part of that journal a correspondent who believes the lamp is only in its experimental stage calls attention to some of its disadvantages, which have already been pointed out. Owing to the external heating which is required, the lamp would be used only for indoor lighting. It could not be used for emergencies when an instantaneous light is required. The automatic heater will make the lamp costly; no one seems to know what the price of the lamp is to be.

In a brief article by Mr. Hospitalier, in "L'Ind. Elec.," Feb. 25, he quotes from Du Moncel's book on electric lighting, Vol. 2, p. 57, published in 1883, in which are described incandescent lamps made of a poor conductor, and references are made to the Jablochkoff lamp. In conclusion Hospitalier states that the Nernst lamp is, or appears to be, very promising; he considers it a development of the original invention of Jablochkoff of 1877.—Hospitalier. "L'Ind. Elec.," Feb. 25.

An abstract of the discussion of Swinburne's recent paper is published in the Lond. "Elec.," Feb. 24. An illustrated extract from the Jablochkoff patent is given in the Lond. "Elec. Eng.," Feb. 24.

Power.

REFERENCES.

Steam Turbines.—The first part of an article, the present portion being historical in character, calling attention to early patents, some of which are fifty years old.—Rankin Kennedy. Lond. "Elec. Rev.," Feb. 17.

Electric Elevators of the Brighton Tower.—A brief, illustrated description of the motors and elevators for the new tower, which is 540 feet high.—Lond. "Elec. Rev.," Feb. 24.

Traction.

MEASURING THE LEAKAGE CURRENTS IN ELECTRIC RAILWAYS.

In a very long paper by Dr. Kallmann, reprinted in the "Elek. Zeit.," Feb. 23, he discusses at considerable length the question of return currents through the rails and the earth, and the various methods that have been suggested, the results of measurements made in Berlin, etc., and finally describes his own method for measuring the currents in the rails. Like most of that author's papers, it is very voluminous, and is largely introductory in character, the chief part of interest to Americans being the method which he describes for measuring the rail currents by a direct method. The methods of diminishing what he calls the vagabond currents, meaning those which leave the rails, are not considered, as the methods which have been suggested are thought to be too artificial and not appropriate. He does not consider the usual method of measuring the difference of potential between the rails and the metallic masses of the earth as being a sure indication of the strength of these vagabond currents; such a measurement does not indicate the actual current which flows, and it is on the latter that the electrolytic action depends, a fact which he thinks has not been sufficiently well recognized. There are in general two kinds of methods, those made when the line is not in operation and those made when it is. The former depend on the measurements made on a separate piece of the line, the conductivity and insulation of which is to be measured, from which the leakage is calculated. A somewhat simple and general, but largely inapplicable, formula is given, on the assumption that some of the current leaves the rails and joins them again. He then reviews the methods and results of the official tests in Berlin, and others in America. One of these is to pass an accumulator current through a definite length of the rails, measuring the current as it enters and again through a joint in the rails which has been opened; thus the difference of the two currents indicates the leakage current. The readings were taken with a voltmeter, used as in the potentiometer method, along various lengths of the track; about 100 amperes were used; this leakage current, however, cannot be assumed to be the same as that in actual practice. A modification of this method is also described. The method recently described by Herrick is discussed. It is not believed that the methods used in America suffice, at least for the determination of these vagabond currents, and that there is a great want of a method of determining this. He then describes his method, based on the same principle as that of his insulation indicator, described in his recent paper, abstracted in the "Digest" Nov. 5 and 12, in the first of which abstracts the general diagram of the method is reproduced. In this two portions of the rails are used as shunts for the two coils of a differential galvanometer; the reading of the galvanometer thus gives the difference between the two currents in the two parts of the rails—that is, a direct reading of the stray earth or vagabond currents; it supposes, of course, that there is no car between these two points when the measurement is taken. The illustration reproduced in the "Digest" Nov. 5 shows the present arrangement of the method applied to rails, the main circuit in that illustration representing a rail or track. To calibrate the instrument he suggests using a portable accumulator for passing a current of 20 amperes through one of the lengths, from which the potential wires are to be taken, and then adjusting the resistance of the instrument; then take the accumulators to the other portion and again making the adjustment. The lengths through which these currents should be passed had best be about 25 metres, and the two or four rails should be well bonded together with cross bonds at those places; the length to which the potential wires should be adjusted had best be about the length of one rail—that is, approximately 10 metres. By means of the external resistances of the galvanometer, he suggests adjusting the readings so that one degree represents just one ampere in the rails. The adjustment and application of the method is described in detail. For a large network of rails he believes it sufficient in general to adapt this method to about five or ten important parts of the road, and preferably to parts which are not branched. (He lays no stress on the fact that this method requires that two galvanometer wires be run to each of the two sections, thus requiring four such wires for each test. When the distance from these points to the station is great this becomes a serious item in the expense.)—Kallmann. "Elek. Zeit.," Feb. 23.

CONSOLIDATED COMPANY OF PITTSBURG.

A long, well-illustrated article on the power station, repair shops and car houses of the Consolidated Traction Company, of Pittsburg, is published in the "St. Ry. Jour." for March. This company is a consolidation of several smaller ones, and had several small stations which have now been replaced by a large one located in about the middle of the system, a change which is expected to result in a station economy of about 56 per cent. The new station has a capacity of 12,500 horse-power, consisting of eight 1560-hp engines, which are specially designed and possess a number of novel features, including the use of a screw and wedge adjustment for the valve gear. The main bearings for the shaft are 20 inches in diameter and 40 inches in length, for a 44,000-pound armature, and 110,000-pound fly wheel. Smoke-consuming furnaces and automatic coal conveyors are used. There are three storage-battery stations, each located about 3 miles from the power station, two having a capacity of 500 ampere hours each and the other 1000 ampere hours. One tower wagon is of the automobile type, with storage batteries. The generators and switchboard are arranged so that the road can be operated on the three-wire system if desired; in this case all the

lines in the lower section of the city will be run at 500 volts positive, and those in the outer part of the city at 500 volts negative, the rails being neutral. Certain sections are then arranged to be thrown from one side to the other, to keep the balance on the system. The switchboard is located in a separate room, in four tiers. The switches are all operated by pneumatic appliances, which are controlled from a stand on the upper deck or roof of the room. The stands are all numbered, and there is one for each feeder and one for each generator. On the top of each stand is a red lamp, which lights automatically when the corresponding circuit breaker opens. The switches for throwing the feeders are interlocked with those for the circuit breaker, so that it is impossible for the attendant to make a mistake in throwing in the switch when the circuit breaker is out. The repair shops are fully equipped with all necessary machine tools. The floor is paved with brick, and the shifting of cars is done by a traveling crane having a capacity of about 20,000 pounds. One of the most interesting features of the repair shops are the dismantling pits, which are so arranged that a pair of wheels or both axles, with their motors, can be removed from the track and a new set substituted within twenty minutes, only five men being required. The repair shops and car houses are heated by hot air. The cars are equipped with the new General Electric brake, which is fully described.—"St. Ry. Jour.," March.

GENERAL FORMULA FOR TRAIN RESISTANCE.

In the "Digest," March 25, the new formula of Lundie was described; the "St. Ry. Jour." of March contains an article and a series of letters commenting on this formula. In an article by Mr. Blood he considers the method of determining the train resistance by direct measurements of the power required by trains in service superior to that in which the measurements are taken while the train is coasting, as with the Lundie measurements. He gives the history of the different formulas that are used; some of the earlier ones are based on the square of the velocity, but were found to give too high results for high speeds. Lundie's formula does not include the friction of the cars and bearings, which the present writer considers a mistake. In the formula proposed by Blood the speed has an index—that is, is raised to a power which is greater than one and usually less than two. Various curves are shown, one giving the results from that formula, the power of the velocity being 1.8; another set shows how the various formulas compare; another shows how this formula agrees with tests on trains of light weight; in another it is compared with the results of Lundie's experiments, and a fifth shows the equation plotted for all speeds up to 100 miles an hour.

In a series of communications commenting on the Lundie formula Professor Swain doubts if a correct formula covering every case can be devised; he considers this one better than Clark's, but believes that S should be raised to a greater power than the first. Knox gives the results of tests for train resistance on different kinds of rails, showing the great increase on badly worn rails; he considers the condition of the rails very important. Tesla doubts whether a formula which does not contain the square of the speed can be true for widely different values. Rockwell states that as the formula is an empirical one, it is impossible to state whether the numerical values in it are correct, outside of the conditions under which the tests were made.—"St. Ry. Jour.," March.

INSPECTION OF STREET CAR EQUIPMENTS.

A paper read before the Franklin Institute, by Mr. Herrick, is reprinted in the "St. Ry. Jour.," March. It gives practical directions for inspection of car equipments. He first discusses the common type of controller, in which there are nine positions of the controller handle, the motors being put in series at position No. 4; steps 1, 2 and 3 cut out resistances. The resistance of the rheostats used usually increase with age and non-attention, and much trouble is often caused if they are in poor condition. If the resistance on the first step is too high, the motors will "jump" at the second step, with a resulting increase of heat in the motors. Too low a resistance on the first step will have the same result if that on the second step is normal. He then discusses another type of controller, and points out its defects, if the resistance is in improper condition. To test the resistance of the rheostats and motors it is necessary to use a large current, as the contacts give variable and unreliable results when measured with a low-potential test current. The author then discusses the bridge, the Thompson, and the volt and ammeter methods of testing resistances, pointing out why they are unsatisfactory in this case, and why a differential method of his own, which is simply a modification of the Kelvin method, is more desirable. He describes a testing set by which all resistances in different circuits at the different steps of the controller can be determined, and gives results of tests made by this instrument on ten different equipments with K 2 controller. Short circuiting in the field coils is a prolific cause of trouble, and he describes various ways of insulating the coils. If they are afterward baked in an oven the latter should be arranged with ventilators to conduct off the vapor rising from the coils when heated. He also describes a method of testing for short circuits between commutator bars, and for testing fields.—"St. Ry. Jour.," March.

BOLTON, ENGLAND.

A long, illustrated description of the corporation electric railways in that city by the borough engineer, Mr. Ellis, is published in the "St. Ry. Jour.," March. The lines of this city will soon be operated electrically over a total length of about 30 miles. The rails weigh about 90 pounds per yard, and are laid on concrete; the poles are of steel; the types of brackets used are illustrated. The feed wire is carried underground, and the connection to the trolley wire is made through the boxes carried on the poles containing switches, etc. Positive and negative boosters will be used on the long routes. There will be seventy double-deck cars, equipped with two 30-hp motors, which can be short-circuited to act as an emergency brake; air brakes and hand brakes will be used in addition. The new generators for the tramway will be installed in the enlarged lighting station owned by the city. The lighting supply at present is on the alternating system with 2000 volts, but the company is changing over to the continuous-current supply for the central portions of the town, using 460 volts across the outer wires of the system, with 230-volt lamps. The company is installing two 1000-hp vertical Corliss cross-compound condensing engines and two 500-hp engines of the same type, which will be direct connected to the generators. The latter, when working on the tramway wires, will run as compound machines, and when working on the lighting load, as plain shunt machines. The guaranteed efficiency of the engines is 91 per cent. and of the generators 94 per cent. The boilers will be of the Lancashire type, fitted with mechanical stokers, coal-conveyors, super-heaters and economizers. The switchboard will be quite complicated, owing to the variety of machines in use. The connections of the board are shown in detail, and the article is accompanied by a number of engineering drawings.—"St. Ry. Jour.," Int. Ed., March.

ELECTRICALLY DRIVEN CABLE ROAD AT MONT DORE.

A brief, illustrated description of this mountain railway in France, abstracted from a French journal, is published in the "Elek. Zeit.," Feb. 23. The source of power is hydraulic; three-phase current at 3600 volts is used to drive the single motor at the top of the incline, which operates the cable. The generator is connected to the turbine through a flexible coupling, and there is in addition a heavy flywheel of 1800 kg, in order to compensate for the current rushes at the starting of the motor, when the power rises suddenly to about 80 horse-power. The generator has a capacity of 138 kilowatts. The motor is a non-synchronous one, the armature having a large diameter, but a short length, in order to reduce the magnetic leakage; it is provided with three slide rings, which enable starting resistances without self-induction to be inserted. The two cars are connected to the two ends of the cable, and pass each other in the middle of the trip as usual; it thus becomes necessary to change the direction of rotation of the motor for each trip, for which purpose a special switch is provided, the diagram of the connections of which is given; one of the three currents flows through it in the same way, while the other two are transposed by the switch. At times the descending car is on a steeper grade than the ascending, thus driving the motor as a generator and sending current back to the dynamo. This road is said to be the first of its kind in France, and the first in Europe in which three-phase currents of high voltage are used directly in the motor.—"Elek. Zeit.," Feb. 23.

SURFACE CONTACT TRACTION SYSTEM.

A reprint of an illustrated Institution paper on the Thompson-Walker system, which was described in THE ELEC. WORLD Oct. 22, is published in the Lond. "Elec.," Feb. 17 and 24. The present paper describes the system in its latest form. The discussion is noticed briefly in the Lond. "Elec. Rev.," Feb. 24, and is given in abstract in the Lond. "Elec.," Feb. 24, in which it is editorially criticised as being very inane. The editorial states that in the discussion not a single defect was pointed out which could reasonably justify railway authorities in declining to make a trial of the system on the public highways. The whole paper and the discussion are published in the Lond. "Elec. Eng.," Feb. 24.

LOCOMOTIVES FOR CITY AND SOUTH LONDON R. R.

A very brief, illustrated description of one of the ten locomotives which the Crompton Company is building for that underground railway in London. The chief points in which it differs from the others in use is the introduction of the series parallel controllers. The motors are four-pole machines; the armatures are mounted directly on the axis; the motors are more powerful than those originally used. Excepting the illustrations, this is practically all the information given.—Lond. "Elec. Rev.," Feb. 24.

TITUSVILLE, PA.

A short article on an interurban railway through this town. The line passes through four towns, having a total population of about 15,000, and is about 10 miles in length, a large part of which is over the company's own right of way. The power station contains one 110-kw and one 325-kw generator, connected to engines of the Corliss type, with certain novel features. Natural gas is used as fuel, and the monthly consumption of gas since the road began is 52,000 cu. ft., costing 10 cents per cu. ft.—"St. Ry. Jour.," March.

REFERENCES.

Public Cabs in Paris.—The beginning of an article, accompanied by a number of drawings, descriptive of electric cabs of the Compagnie Générale in Paris, a company which intends to operate public conveyances of this kind. The Jeantaud and the Krieger cabs are briefly described.—Lond. "Engineering," Feb. 24.

Power Station Records.—A detailed statement of the cost of operation of the Trenton Railway Company's power station for 1898, per car mile. The car miles in 1898 were 1,612,608, and the cost per car mile for power was 1.1 cents.—"St. Ry. Jour.," March.

Small Locomotive for Underground Haulage.—A brief, illustrated description of the one used in the tunneling for the new underground electric railway between Waterloo and Baker Streets, London.—Lond. "Elec.," Feb. 24.

Three-Phase Railway Transmission in Maine.—Further particulars concerning the Brunswick, Bath & Lewiston Railroad, a description of which was given in The Elec. World March 4.—"St. Ry. Jour.," March.

Tests of Power Consumption on Railways.—An abstract of the article noticed in the "Digest" Oct. 29 and Dec. 31.—Schiemann. Lond. "Elec. Rev.," Feb. 17.

General Observations on Electric Traction.—A reprint of the paper abstracted in the "Digest," Feb. 18.—Parshall. "St. Ry. Jour.," March.

Installations, Systems and Appliances.

COMBINATION OF A CENTRAL STATION AND A PRIVATE PLANT.

In a short article in "L'Ind. Elec.," Feb. 25, by Mr. Meynier, he discusses the advantages of connecting a private plant in parallel, as it were, with a central station, enabling each to assist the other. He cites a case in which a saw-mill whose load was too variable to be connected with the station was provided with a separate turbine and dynamo, and was electrically connected with the central station at Fecamp, in France, of which that writer has charge, the two assisting each other to their mutual advantage. A diagram of the connections is given, and shows the arrangements of the two meters, one of which measures the current when it is in one direction and the other when it is in the opposite direction.—Meynier. "L'Ind. Elec.," Feb. 25.

MANCHESTER.

Some brief references to this very successful station. A scheme is about to be carried out which will make this the largest central station in England, and the most conspicuous example of three-phase work in Europe. It is intended to light the outlying portions of the city over an area of about "40 miles," and for this it is recommended to use a three-phase transmission with continuous-current distribution. The municipality is also acquiring the tramway system, which is to be run electrically. Work is soon to be begun. —Lond. "Elec. Rev.," Feb. 24.

REFERENCES.

Bolton.—A brief description of the changes at this station, a portion of the territory supplied by which is to be changed over from the alternating to the continuous current system, partly because the present feeders are fully loaded; also on account of the transformer losses, the great demand for motive power and the fact that railways are to be supplied from the same plant.—Lond. "Elec. Rev.," Feb. 24.

Para.—A translation in part, with a number of the illustrations, of the descriptive article noticed in the "Digest" March 4.—N. Y. "Elec. Eng.," March 2.

Wires, Wiring and Conduits.

HEATING OF LEADS AT NO LOAD.

An editorial in the "Elek. Zeit.," Feb. 23, calls attention to the fact that cables for alternating currents become heated when they are connected to the generator, but deliver no current at the distant end. With low voltage this is scarcely perceptible, but with the use of such high voltages as 6000, and even 10,000, transmitted in cables, this heating may become quite an important matter. There is a difference of opinion as to the cause, some engineers claiming that it is merely the Joule effect, due to the leakage current from one conductor to the other through the insulation, while others explain it by a sort of electric hysteresis in the insulating material. In practice it is immaterial which of the two is the correct explanation, or whether both act together, the important problem being to determine this loss and to reduce it as much as possible. The method of Rosa and Smith, noticed in the "Digest" Feb. 4, for measuring the energy loss in condensers is then briefly described, and although the method was not applied to cables, it is thought that for that purpose it might give very good results. It is thought that for accuracy and simplicity this method leaves nothing to be desired.—"Elek. Zeit.," Feb. 23.

REFERENCES.

Standardizing Line Wires.—A number of firms in Austria and Hungary have agreed on some standards for wires. They have adopted certain standard cross-sections and types of insulation, a brief description of which is given in the "Zeit. fuer Elek.," Feb. 19.

Electro-Physics and Magnetism.

VARIATION OF THE CAPACITY WITH THE FREQUENCY.

The dielectric constant of some substances has been found to vary, depending on the frequency of the alternating current used to measure it. Mr. Hanauer has recently investigated this, and described his researches in the "Wied. Ann.," 65, p. 789, the conclusions of which are given in the "Zeit. fuer Elek.," Feb. 19. With both solid and the better conducting liquid dielectrics different capacities were found, with changes in the frequency of the current. With solid dielectrics there is in addition a loss of energy which increases with the duration of the oscillation and which is greater the greater the change in the capacity with the frequency. This was found to be the case with materials which show a strong tendency toward residual discharges. Calculations show that the capacity of a dielectric in layers, as well as the energy lost therein, is similarly dependent on the frequency, and it is therefore possible that the heterogeneity of the dielectric is the cause of the observed phenomenon. With liquids the observed change in the capacity with the frequency becomes smaller after platinizing the electrodes; calculations show that the polarization has a similar action, like the one observed, on the capacity of a liquid condenser, and it is therefore assumed that galvanic polarization is the chief cause of the observed change in capacity.—Hanauer. "Zeit. fuer Elek.," Feb. 19.

REFERENCES.

Reflection of Cathode Rays.—An abstract of a Royal Society paper describing researches with so-called para-cathodic rays.—Swinton. Lond. "Elec. Rev.," Feb. 24.

Magnetic Properties of Samples of Iron.—A translation in abstract, including tables of data, of the article noticed in the "Digest" March 12, 1898.—"L'Eclairage Elec.," Feb. 25.

Electro-Chemistry and Batteries.

REFERENCES.

Accumulators.—A short description of the theory advanced by Hoppe, which was noticed in the "Digest" Nov. 19 and Dec. 10, in which he arrives at the conclusion that the reactions would be reversible if there were no concentration currents, and that the best way of increasing the efficiency of accumulators is to prevent such concentration currents as much as possible. This is followed by a brief, illustrated description of the various forms of accumulators taken from patent specifications.—"L'Eclairage Elec.," Feb. 18.

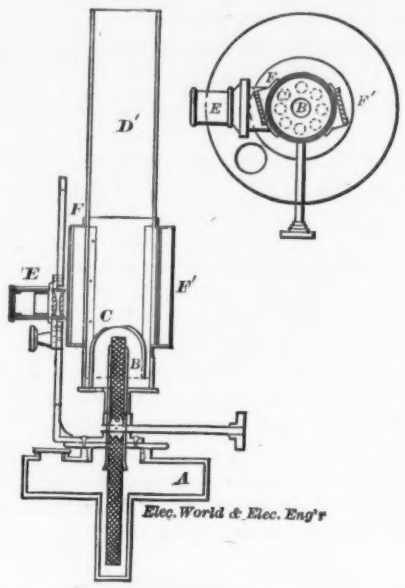
Automobile Accumulators.—Some data of the type of accumulators made specially for traction by the French company controlling what is known as the chloride accumulator. Presumably the cells are the same as those made by the corresponding company in this country.—Lond. "Elec. Rev.," Feb. 24.

Units, Measurements and Instruments.

NEW STANDARD LAMP.

A new standard lamp devised by Professor Blondel, and involving some interesting features, is described by him with the aid of a good illustration, in "L'Ind. Elec.," Feb. 25. It is intended not so much as a standard which can be reproduced to have the same in-

tensity, as was the intention with the Hefner lamp, but more as a secondary standard which can be calibrated once for all. Although it is convenient in some respects to have a standard of greater intensity than the candle, yet he prefers making this equal to the Hefner unit as distinguished from a multiple of ten or twenty times this; among his reasons for doing this are the following: That the liquids used are somewhat expensive; for continuous working it is generally preferable to use incandescent lamps as a secondary standard, the standard lamp being used only to determine this secondary standard; for measurements of illumination as distinguished from intensity a standard low value is better than a brighter one; flames of small diameter are more easily defined than large ones; and, finally, the air in the photometer room is vitiated less rapidly than would be the case with a very large standard lamp. The principal novelties introduced in the present form are that he uses a different liquid and that the lamp is constructed so as to be shielded from very large currents. The liquid consists of 16 per cent. by volume of pure "crystallizable" benzine and 84 per cent. of absolute alcohol. The cross-section of the lamp is shown in the adjoining figure.



The lamp is provided with a sight for adjusting the flame to an exact height. Surrounding the tube through which the wick passes is a cylinder with a hole at the top, a trifle larger than the arc, and just above the top of it; this acts as an air chamber and provides for a proper access of air to the flame; the draught being very good, the flame is very stable, and the combustion very active. The flame is surrounded by a chimney made of metal, which is coated on the inside with a dead-black surface, and is provided with two openings or windows covered with glass; these are arranged on opposite sides of the flame, but are oblique to the rays as they pass out from the flame, as shown, the object being to allow only the direct rays and not any of the reflected rays, to pass from the flame to the photometer screen; in lamps having a chimney such as the Carcel, the rays reflected by the chimney form an important part of the total. Through one of these windows the light passes out to the photometer, and through the other the height of the flame is adjusted. Besides the advantages already mentioned he adds that the construction is simple, the composition of the combustible is well defined and stable, the flame is very stable, the lamp will keep its constant longer, as the wick is not burned, the definition of the flame is sharp owing to its small diameter, there are no parasitic reflections, and, finally, the lamp is quite portable and light. In conclusion he gives instructions for using the lamp. It seems necessary to empty the lamp after a test and not let the liquid stand unused in it for any length of time, as the liquid might absorb moisture; any moisture is shown by the liquid becoming turbid; for this reason it is necessary to use absolute alcohol and to keep the liquids in well-corked bottles. The lamp should be lit for a half hour before the test begins, so as to enable all the parts to attain the normal temperature. A difference of 1 mm in the height of the flame makes an error of about 2 per cent. He also recommends that the photometer room be well ventilated, that the humidity in the air be reduced as much as possible, and that all draughts should be avoided. —Blondel. "L'Ind. Elec.," Feb. 25.

WEHNELT ELECTROLYTIC INTERRUPTER.

The exceedingly interesting discovery recently made by Wehnelt and described in the "Digest," Feb. 25, has been investigated by Prof. E. Thomson, who describes the results of his investigations, together with some modifications, in the N. Y. "Elec. Eng.," March 2. After describing in detail how this simple apparatus may be made, he states that the secondary discharges are of a uni-directional character when the spark length is such that individual discharges or sparks are obtained at each interruption, without jars or condensers, but when the arc is formed between the terminals it is doubtless alternating, at least in part. The interruptions are very sudden; the increase of the primary current is dependent largely on the inductance in its circuit; the secondary voltage is therefore greater when the primary current is broken than when it is made. The interruption occurs when a certain current density is reached at the platinum anode surface; this current density depends on the time constant of the circuit or on its inductance. The speed of interruptions may be increased or decreased by varying the exposed surface of the platinum wire, or the inductance, as by adding or cutting out coils or using sliding cores, etc.; also by changing the applied voltage. If the inductance is greatly increased, the interruptions may be brought down to 10 or 12 per second, and probably lower. On the other hand, a wire core with a few turns of copper around it may give such a low inductance that the frequency will be enormous. It is not difficult to obtain thousands of interruptions per second, and the induction coil then behaves much like a high-frequency apparatus; it may be made more like it by shunting the interrupter with a condenser in series with a slight induction. At the highest frequencies, alternating discharges are produced. On the formation of the secondary arc discharge, the note which is heard, arises—that is, the frequency is increased because the primary current then reaches the limiting value for the interrupter in less time. When the secondary is open a very loud noise is made in the interrupter, which disappears largely when the secondary is discharging. During the action the platinum point is surrounded by a pinkish-yellow glow and emits oxygen gas. He suggests the following explanation of the action: When a certain current density is reached the wire becomes a positive crater like in an arc, or the electrolyte is at least heated so as to decompose into oxygen and hydrogen, the former being in excess; this layer insulates the wire and stops the current, when the gases reunite with an explosion, the excess of oxygen passing out as bubbles; the liquid then touches the wire again and the process is repeated. Two such interrupters may be worked in parallel, but they will then operate only with a higher current; he suggests a set having values of 5, 2 and 1, like in a set of weights, so that by various combination any value from one to ten might be obtained; it seems, however, that the interruptions are then not so sharp. He illustrates such an arrangement in which there are four platinum points in parallel, each with a different inductance in series with it. The ordinary Roentgen-ray tubes cannot survive the energy given by the interrupter, but smaller coils may be used. There is great danger in melting the platinum anti-cathode. He seems to question whether the intensity of the rays is increased. The response of the interrupter to the closing of the circuit is so instantaneous as to be of value in certain kinds of work. Thus, in X-ray pictures of the chest, the closure may be timed with the breathing movement; or, in Hertzian-wave telegraphy, the signals may be made by a key in the interrupter circuit. In conclusion he describes and illustrates a multiple interrupter utilizing this principle. One of the advantages is that it is surrounded by a water bath to keep it cool, for if the acid becomes heated to near its boiling point, the interrupter fails to act.—E. Thomson. N. Y. "Elec. Eng.," March 2.

A NEW FORM OF MAGNETOMETER.

Mr. Guillet has devised a simple magnetometer for rapid measurements of the modifications of magnetization produced by percussion, heating, etc., a description of which is given in the "Comptes Rendus," Jan. 2, abstracted briefly in the Lond. "Elec.," Feb. 24. It consists of a metallic square suspended by a thin wire and carrying a hollow, metallic cylinder beneath it, the plane of the square and the axis of the cylinder being both vertical. A current is led through the suspension wire, the two sides of the square, the cylinder, and then led out through two fine silver wires. The pole strength of a bar magnet is measured by the magneto-electric deflection, which it produces when the pole is inserted into the cylinder from below. The formulas are said to be simple, and the deflection is accurately proportional to the pole strength. The posi-

tion of the pole in the magnet is determined by gradually pushing it into the square until the latter shows a maximum deflection; the pole is then in the plane of the square. From the pole strength and the magnetic length of the bar, the magnetic moment becomes known. The same apparatus may be used as a ballistic galvanometer or as an electro-dynamometer.—Guillet. "Comptes Rendus," Jan. 2; Lond. "Elec.," Feb. 24.

ALKALIMETRIC MEASUREMENT OF DISCHARGES.

For measuring the quantity in the discharges of condensers Professor Cardani describes an alkalimetric method in "Nuovo Cimento," Feb., 1898, a brief abstract of which is given in "L'Eclairage Elec.," Feb. 18. He used a normal solution of chloride of sodium diluted 200 times; to this is added the coloring material phtaleine of phenol, which colors an alkaline liquid red; sufficient oxalic acid is added so that the color is pale rose. This is separated into two equal parts for comparison; one of these is placed in a tube with a positive electrode of silver, which will absorb the chlorine, and a negative one of platinum. After passing through this a thousand discharges, for instance, sufficient oxalic acid is added so as to produce the original color again. From this amount of oxalic acid the quantity of sodium separated out, and therefore the quantity of electricity which passed, may be calculated.—Cardani. "Nuovo Cimento," Feb., 1898.

REFERENCES.

Apparatus for Measuring the Torque of Motors.—An illustrated description of the Boucherot apparatus, which was noticed in the "Digest" Feb. 11.—"L'Eclairage Elec.," Feb. 18.

Telegraphy, Telephony and Signals.

REFERENCES.

Telephone Switchboard.—A brief, illustrated description of a new switchboard, which is claimed to be very ingenious, and is made by the large French telephone company; it is in use at Saint Mande.—"L'Eclairage Elec.," Feb. 25.

Detectors for Magnetic Space Telegraphy.—An abstract of the author's recent paper, including reproductions of a number of the various forms of detectors which he described.—Lodge. N. Y. "Elec. Eng.," March 2.

Miscellaneous.

CONNECTION OF STEAM PIPES TO LIGHTNING RODS.

Several communications are published in the "Elek. Zeit.," Feb. 23, in reply to the inquiry noticed in the "Digest" March 11. All four of the correspondents agree with the remarks made by Mr. West. Mr. Findeisen believes that a single connection and earth plate are not sufficient, as there should be at least two, and preferably four, separated some distance from each other, each being connected to the underground water pipes and to an earth connection laid in the moist upper surface of the ground. Such connections should also be made to the boiler, preferably at the blow-off valve at the bottom. He knows of no case in which damage was done to the boilers, although undoubtedly many have been subjected to the effects of lightning. Mr. Walloch cites a case in which the lightning struck the wall between two boilers, producing a sufficiently great explosive effect to throw one of the boilers, weighing at least 30,000 kg, against its neighbor. It appears that the boilers had no proper earth connection, and if they had been so provided he thinks this would not have happened. He recommends that not only boilers but all other construction should be thus protected. Dr. Strecker quotes some rules concerning such connections of boilers. Mr. L. Weber states that the branch connections should be as far apart as possible, especially in vertical directions. If a building has no lightning rod the presence of steam piping, which by itself would increase the danger to lightning, is a good reason why a lightning rod should be added.—"Elek. Zeit.," Feb. 23.

ELECTRIC HEATER.

In a further brief, illustrated description in "L'Elec.," Feb. 25, of the Le Roy heating device, which has already been described in the "Digest," the following data are given: It will be remembered that the apparatus consists of a rod of silicon enclosed in a vacuum tube. It is made in the form of small units, which are easily handled and inserted in clamps. For 110 volts the rods in general are 100 mm long, 10 mm wide and 3 mm thick. This will take about 150 watts; the surface is equal to 26 sq. cm., and the dissipation of heat is therefore at the rate of about 5 kg calories per sq. cm. of surface, or an absorption of electric energy at the rate of 6 watts per sq. cm. of surface. As compared with wires such as are ordinarily used, the ratio of radiating surface is as one to four or one to six.—"L'Elec.," Feb. 25.

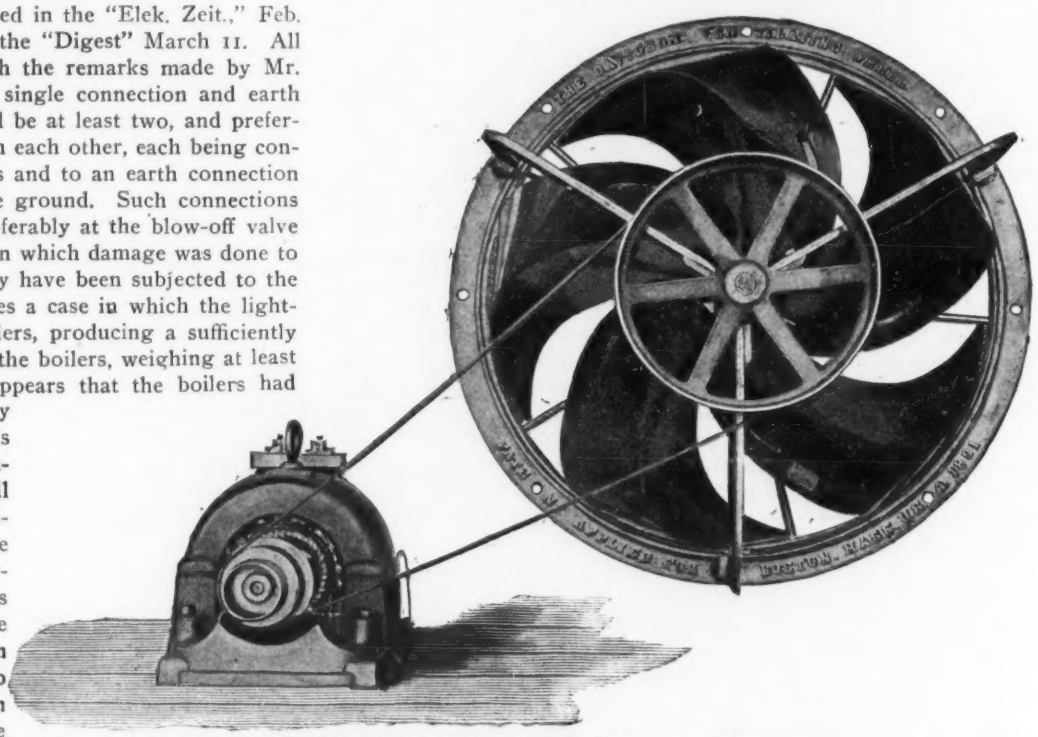
REFERENCES.

Electricity for Medical Purposes.—A reprint of an article read before a French medical society on currents from electrostatic apparatus, in which the author defends the use of static induced currents and describes a further method of applying such currents, which he found to be invaluable in the treatment of diseases.—W. J. Morton. N. Y. "Elec. Eng.," March 2.

Mechanical Applications of Electricity.—Brief, well-illustrated descriptions of various applications, taken from patent specifications.—Richard. "L'Eclairage Elec.," Feb. 25.

Wagner Alternating-Current Ventilating Fan Outfit.

The combination shown in the accompanying illustration has been designed by the Wagner Electric Manufacturing Company, St. Louis, Mo., to meet the existing demand for a reliable alternating-current motor ventilating fan outfit. The motor and fan are connected together by belt, the speed adjustment being secured by means of cone pulleys placed upon the motor shaft. In the standard arrangement the motor has a two-step cone, so proportioned as to drive the fan at full speed or about two-thirds speed, these speeds corresponding to the full and one-half load on the motor. The motors furnished with these outfits are of single-phase self-starting induction type. They can be wound for any of the frequencies in general use, and are regularly made for 60 cycles per second and 133 cycles per second, corresponding to 7200 and 16,000 alternations per minute, respectively. Outfits for 60 cycles are made in seven sizes, ranging from one-half to 7½ horse-power, and for 133 cycles from one-quarter to 5 horse-power. The capacities in cubic feet of air per minute for both classes of outfits are from 3360 to 37,300 for the high speeds, and from 2000 to 24,800 for the low speeds. The motors are self-starting and entirely automatic in their operation, requiring the minimum of care.



ALTERNATING-CURRENT VENTILATING FAN OUTFIT.

The same guarantees are made for these motors as are given by the manufacturers of the leading direct-current motors. They may be operated from single-phase circuits or from either phase of two or three-phase circuits.

NEWS OF THE WEEK.

Financial Intelligence.

COMMERCIAL CABLE COMPANY has declared a quarterly dividend of 1¾ per cent., payable April 1.

WESTERN UNION TELEGRAPH COMPANY has declared a regular quarterly dividend of 1¼ per cent., payable April 15.

THE COLUMBIAN ELECTRIC CAR LIGHTING & BRAKE COMPANY, which was recently incorporated in New Jersey, has increased its capital stock to $10,000,000.

NEW YORK EDISON assents to the proposed exchange of stock for bonds under the plan of absorption by the New York Gas & Electric Light, Heat & Power Company are said to reach over 92 per cent. of the stock, virtually ensuring the success of the proposition.

THE UNITED RAILWAYS & ELECTRIC COMPANY, of Baltimore, has authorized the execution of a mortgage for $38,000,000 in favor of the Continental Trust Company to secure an issue of a similar amount of 4 per cent. bonds. The revenue stamps on the mortgage amounted to $19,000.

OUT OF TOWN STOCKS during the week presented many features of spectacular interest. In Boston American Bell Telephone closed around 341. In Philadelphia Electric Storage Battery remains in demand, and in Chicago National Carbon is now an active trader. Few stocks have ever shown the elasticity of Storage Battery, which last month sold at a price 750 per cent. of its market value of March last year. The inherent merits of storage batteries "will not down," either in stock markets or central stations.

DIVIDENDS.—The North Shore Traction Company has declared a semi-annual dividend of 3 per cent. on its preferred stock, payable on April 1. The Philadelphia Traction Company has declared a semi-annual dividend of $2 per share, payable on April 1. The Chicago City Railway Company has declared its regular quarterly dividend of 3 per cent., payable on March 31. The Electric Vehicle Company, of New York, has declared a dividend of 8 per cent. on its preferred stock, and a 2 per cent. quarterly dividend on the common stock. The books will close on April 1.

THE WEEK IN WALL STREET was one of sensitiveness, with a distinct gain of strength and confidence towards the close, especially after the appearance of the bank statement, and following also upon the general gains in trade and the numerous advances in wages all over the country. During the week 7902 shares of Western Union were sold, opening at 93¾ and closing at 94⅛. General Electric was strong on operations in 15,485 shares, with a rise to 120½, closing at 118½. How are the fallen mighty again! New York Edison was dull around 193-4. Metropolitan Street Railway on sales of 67,727 shares rose to 256. and closed at 252. The potentiality of this stock has not yet found its limit. Am. Dist. Telegraph, on sales of 13,221 shares, sagged from 51 to 48.

TRENTON, N. J.—It is announced that Redmond, Kerr & Co. offer at 102½ and accrued interest the unsold part of $1,500,000 Trenton Gas & Electric Company first mortgage 5 per cent. fifty-year gold bonds, being part of a total issue authorized by the mortgage of $2,000,000, the balance of $500,000 to remain in the treasury for actual extensions and improvements under careful restrictions. A letter from Henry C. Moore, president of the company, attached to the announcement, states that the Trenton Gas & Electric Company controls either through actual ownership or ownership of stock all the gas and electric light plants in the city and suburbs of Trenton, the earnings of which last year were far more than the fixed charges, and will be largely increased under the present management, while the operating expenses will be much reduced as a result of the consolidation.

NEW YORK TRACTION STOCKS supplied their share of the fluctuations of the week. Third Avenue was a leader. At the close Monday it showed a net decline of 9 points; on Tuesday, another 9 points; on Wednesday, a net advance of 6 points; on Thursday, a net gain of 7 points, and on Friday another net advance of 11½ points. The ostensible reasons for these fluctuations were to be found in the fact that at the beginning of the week the company was enjoined from pushing work on the the Amsterdam Avenue sub-trolley line, and that on Thursday the Grady movement to the Ford bill passed the Senate. Metropolitan Street Railway sold up from 235½ to 256 on Friday, as noted in another paragraph. The 20-point advance was said to foreshadow some very favorable developments. Among other things it was said that a 10 per cent. scrip dividend would be declared and also that there would be a new issue of stock to which the present stockholders would be allowed to subscribe at par. Brooklyn Rapid Transit was another stock which made a substantial gain for the week.

TRADE CONDITIONS.—In their weekly review of trade, R. G. Dun & Co. remark: "By far the best assurance of good business in the future is found in the general rise of wages. Traders and manufacturers can sell only when wage earners can buy, and in proportion to their buying powers. The general advance in earnings of cotton mill operatives, in most cases 10 per cent.; of iron and steel workers generally 10 per cent.; of tin plate and sheet workers from 5 to 10 per cent., and of coal miners, in some large districts, about as much, has set a pace which most establishments will follow which have reduced wages in past years of depression. Those who fail to comprehend what such a change may mean have only to consider that a tenth increase in the wages of all labor would put into the markets a new buying demand in amount about three-quarters of the entire value of exports to all countries. The volume of business shows no signs of decrease, and for the first full week of March has been about 51.7 per cent. greater than in the same week last year, and 60.9 per cent. greater than in 1897."

Special Correspondence.

NEW YORK NOTES.

MR. CHARLES F. BRUSH was a visitor in New York City last week, with headquarters at the office of Mr. George W. Stockly. His interest in technical subjects is unabated, and it is understood that he is still deeply engaged in experimental work.

MR. MAX LOEWENTHAL, recently associate editor of "The Electrical Engineer," has joined the forces of the Electric Vehicle Company, of this city, which is now expanding all its operations considerably and needs plenty of rising talent. Mr. Loewenthal is an electrical engineering graduate of Columbia University, and has done excellent work as a writer, lecturer and designer. He is lecturing this winter on automobiles in the evening schools, for the New York Board of Education.

NEW YORK ELECTRICAL SOCIETY.—The joint lectures of Messrs. Jenks and Wurts at Columbia University last week were, as we noted, a great success, and both were so full of good material as to leave no time for discussion. In fact Mr. Jenks had to omit some of his best "ribbon lightning" pictures, and Mr. Wurts one or two of his most characteristic experiments. Secretary Guy now announces another great treat for the current month in the shape of a special lecture from Prof. Elihu Thomson on "High Voltage Phenomena." The date set for this is March 29, and the society is selecting a good hall for the occasion. During the meeting on March 9 the following new members were elected: Albert C. Jahl, Burnet Company, No. 115 Maiden Lane, New York; T. E. Crossman, No. 29 Broadway, New York; W. H. Lawrence, No. 49 West 26th Street, New York; C. J. Field, No. 30 Broad Street, New York; George M. Warner, Excelsior Electric Company, Brooklyn, N. Y.; George C. Anthon, box 230, New York Athletic Club, New York; Charles Klein, No. 62 East 3d Street, New York.

BUFFALO NOTE.

PAN-AMERICAN EXPOSITION.—At a meeting of the incorporators of the Pan-American Company, held March 7, a board of directors was elected consisting of the following twenty-five incorporators: Conrad Diehl (Mayor of Buffalo), C. W. Goodyear, John N. Scatchard, Joseph T. Jones, George K. Birge, George W. Williams, W. H. Hotchkiss, J. J. Albright, J. M. Brinker, Major T. W. Symons, U. S. A.; George Urban, Jr.; W. Caryl Ely, John B. Weber, John G. Milburn, Harry Hamlin, F. B. Baird, Carlton Sprague, Wm. Hengerer, H. J. Pierce, Geo. Bleistein, F. C. M. Hautz, H. M. Gerrans, H. P. Bissell, E. G. S. Miller, R. F. Schelling. On the following day a meeting of the directors was held and several working committees appointed to take up the matters of administration, site, increase of capital stock, permanent headquarters and State and National exhibits. All committees are hard at work, and a permanent organization will probably be effected during the current month. As the total capital stock authorized by law has all been taken, and subscriptions now in call for about one-third more, with new subscriptions received every day, this matter needs immediate attention. The total issue will be increased from $1,000,000 now authorized to $2,000,000 or $2,500,000, as soon as practicable, and the committee is considering the manner of best securing authority for such increase. As the stockholders now number more than 12,000 it is no easy matter to hold a meeting at short notice. The company has engaged offices in the Ellicott Square building, the public offices opening on the rotunda, and the offices in which the regular work will be done are on the seventh floor.

INDIANA NOTES.

THE NORTHERN INDIANA CONSTRUCTION COMPANY is the name of an organization formed by capitalists for the purpose of building an electric railway from Angolia to Lagrange, and on to Goshen.

AN ELECTRIC RAILWAY KING.—Ex-Congressman Charles L. Henry, manager of the Union Traction Company, running an electric line between Anderson and Muncie, has also become the promotor of many other electric railway projects, and is the electric railway king of the gas belt. Mr. Henry is devoting all his time to the electric railway business. He has made big money in erecting, managing and selling of electric lines, electric light plants and power companies. He is the chief owner of numerous lines connecting the more important cities of the gas belt, and is now engaged in a master stroke to connect them with a line leading into Indianapolis.

CHICAGO NOTES.

POSSIBLE STREET RAILWAY CONSOLIDATION.—What is looked upon as the first formal step to bring together all of the street car lines in this city is the recent incorporation of the Chicago Consolidated Traction Company, with a capital stock of $15,000,000.

ELECTROLYSIS IN CHICAGO.—It is stated that the city's water pipe system has been injured by the electrolytic action of current escaping from the street railway companies' return circuits. Corporation Counsel Thornton has decided to begin damage suits against the three principal surface railway companies in the city for the injury to the pipes.

ENGINEERING SOCIETY LIBRARY, UNIVERSITY OF MICHIGAN

ST. LOUIS NOTES.

THE PHOENIX BATTERY MANUFACTURING COMPANY has been organized in this city, with a capital stock of $25,000, one-half paid in. The incorporators are S. M. Dodd, J. C. Van Blarcom, James Campbell, Allen T. West, Albert Blair, S. B. Pike and Col. S. G. Booker. The company will transact a general electric manufacturing business.

FRANCHISE REFUSED.—The St. Louis County Court has rejected the application of the Maplewood & Jefferson Barracks Railway Company for a franchise to construct and operate an electric railroad from Maplewood to Jefferson Barracks, on the ground that the specifications and application as to the proposed route and other privileges asked for were too indefinite.

ELECTION OF RAILWAY OFFICERS.—The stockholders of the Union, Citizens', Northern, Cass Avenue and Fairgrounds Railway companies, all of which are owned by the National Railway Company, have elected the following named gentlemen of St. Louis as officers and directors: Corwin H. Spencer, W. J. Orthwein, Robert McCulloch, C. N. Duffy, C. C. Orthwein, Richard McCulloch and Smith P. Galt. These then elected C. H Spencer, president; Capt. Robert McCulloch, vice-president and general manager.

CHEAP TELEPHONES.—The Bell Telephone Company has in view a plan to furnish telephone service for residences at reduced rates. The new departure is a six-party line connection for $7.50 per quarter, or $30 per year. Such a line, for outgoing messages, can only be used 500 times a year, or 125 times a quarter. A charge of 5 cents a message is to be made for the first twenty-five messages in excess of 125; 4 cents per message for the second twenty-five, and 3 cents for all succeeding messages. No limit is to be placed on incoming messages. A charge of $39 a year is to be made for four-party line connection. If customers having one of these instruments leave the city they can have the service suspended and use the 'phone just so many more times in the next quarter.

WORLD'S FAIRS.—Colonel E. J. Spencer, late of the Third Regiment, United States Volunteer Engineers, a few evenings ago delivered an address before the Engineers' Club, St. Louis, Mo., on the subject of world's fairs and their engineering features. Colonel Spencer, who was in charge of the contracts and exhibitions of a large electrical company at the World's Fair in Chicago, gave considerable technical information as to that greatest exposition held within recent years. The address was illustrated with lantern slides of the Paris Exposition of 1889, the Columbian Exposition of 1893, and the Omaha Trans-Mississippi Exposition of 1898. A short history of the leading fairs of the last few decades was given by the speaker, who said that all expositions that had been properly managed had been an unqualified success from a financial standpoint.

PACIFIC COAST NOTES.

A NEW TELEPHONE CIRCUIT FROM PORTLAND TO ASTORIA.—The Oregon Telephone & Telegraph Company's 120-mile copper loop from Portland to Astoria, Oregon, was recently opened for business. The intermediate stations are St. Helens, Rainier, Clatskanie, Westport and Knappa.

ESTIMATING ON A MUNICIPAL LIGHTING PLANT FOR SAN FRANCISCO.—The new engineering firm of Hunt, Meredith & Benjamin has taken rooms 6, 7 and 8 in the Stock Exchange building, San Francisco. Mr. A. M. Hunt, formerly of Hasson & Hunt, is preparing the estimates for the cost of a municipal electric lighting plant for San Francisco.

RAILWAY FRANCHISE IN SEATTLE.—A fifty-year franchise for a new consolidation—to include all the street railways of Seattle, Wash.—has been asked for by H. C. Henry, J. D. Lowman, M. H. Young, J. W. Clise, E. F. Sweeney and R. R. Spencer. It is understood that the petitioners expect to sell the franchise, when obtained, to Eastern capitalists. It will cost over $2,500,000 to purchase all of the railways and clear off their indebtedness. It has been conjectured that the purchasers of the Tacoma street railways are interested in this deal also.

STRICT LIGHTING IN PORTLAND.—The Portland General Electric Company's proposition to light the city streets, for the period of two years, from April 1, 1899, for $53,000 per year, was recently accepted by the board of public works of Portland, Oregon. The company's reduction of about $30,000 per year was brought about, in part, by the threat implied when W. Stuart-Smith, consulting electrical engineer, was engaged to report upon the cost of establishing a municipal electric lighting plant. The company entered a vigorous protest against the engineer's estimated cost of an arc light per year, which was $65.70. The company produced figures with greater depreciation of plant, making the cost $85.83.

THE PELTON WATER WHEEL COMPANY, of San Francisco, is constructing four impulse wheels for the Redlands Electric Light & Power Company, of Redlands, Col. This is for an extension and remodeling of the pioneer of long-distance electric transmission in this country. Pelton wheels are driving the generators of the Southern California Power Company's Los Angeles transmission line, which is the longest electric power transmission in the world. Among the recent orders of the Pelton company are: Two water wheels, to be direct connected to electric generators, which will be operated under the extraordinary head of 2020 feet, that being, as far as known, the highest head under which any water wheel has been operated; a 100-hp wheel for an electric light plant in Utah; a 150-hp wheel for an electric light plant in Java; four wheels, a 5000-foot pipe system, etc., for operating sugar mill and electric lighting plant near Tepec, Mexico.

CANADIAN NOTES.

CARBIDE FACTORY IN OTTAWA.—The Bronson & Weston Company's lumber mills in Ottawa are about to be converted into an immense carbide factory. The factory will be operated by a 4800-hp electric plant.

THE CITY OF OTTAWA bill asking permission for the operation of street cars on Sunday came before the Private Bills Committee of the Ontario Legislature. The Mayor of Ottawa and a number of aldermen supported the bill, while a strong deputation from the Lord's Day Alliance Association of the province appeared to oppose its passage. After considerable discussion, during which the chairman of the committee declared himself in favor of Sunday cars in large centres of population, which declaration was endorsed by the leader of the opposition, the bill passed the committee on a vote of 34 to 13.

LARGE ELECTRIC POWER APPLICATION IN OTTAWA.—Mr. J. R. Booth, of Ottawa, has closed a contract with the Canadian General Electric Company, Toronto, by the fulfillment of which the machine shops and new car works of the Canada Atlantic Railway, in Ottawa, will be supplied with electrical power generated at the Chaudiere Falls at the west end of the city. The electric company will install two three-phased generators, each of which will be of 200-hp capacity. The power will be transmitted to the works, 3½ miles distant, by an overhead line. Besides furnishing power for the car works and the machine shops, this energy will operate the locomotive transfer tables, the traveling cranes and the entire lighting system of the different works and adjoining yards. For the latter purpose 100 enclosed arc lamps will be put in service. It is estimated that this power can be furnished at about one-half the cost of the present motive force.

TELEGRAPH LINE FROM SKAGWAY TO DAWSON.—The Dominion Government has decided to construct a telegraph line to connect the Yukon with British Columbia. A party of engineers has left Ottawa for the Pacific Coast, with instructions from the Government to commence at once the construction of the line from Skagway to Dawson City. The estimated cost of the line for the distance of 600 miles between the two points named is $150,000, on a basis of $250 per mile. It is expected that the line will be in operation by November 15 next, and when it is completed Dawson will be brought within six days' communication of Ottawa. Whether the sea link will subsequently be connected by a cable between Vancouver and Skagway, or whether the Government line from Quesnelle, in the Cariboo country, will be extended northward to connect with the Skagway-Dawson line, has yet to be determined. The Government decided that the franchise for a telegraph line to Dawson is too valuable a one, and too important from the standpoint of national safety, to be allowed to go into any other than Government hands.

General News.

NEW INCORPORATIONS.

THE ROCHESTER ELECTRIC MOTOR COMPANY, of Rochester, N. Y., has been formed by John Buckley and Edward F. Davison, Rochester; F. C. Kummel, Greece. Capital stock, $10,000.

THE CHICAGO INCANDESCENT ARC LAMP COMPANY, Chicago, Ill., has been incorporated, with a capital of $7500. Among those interested are Henry R. Platt, Sidney Stein and John H. Hume.

THE WILMINGTON HOME TELEPHONE COMPANY, Wilmington, Del., has been incorporated, with a capital stock of $15,000, by Miletus Garner, S. R. Mitchell, C. R. Fisher, L. J. Walker and S. G. Smith.

THE PRINCETON ELECTRIC WORKS COMPANY has been incorporated at Trenton, N. J., with a capital stock of $100,000. The incorporators are Charles S. Robinson, Frederick Fisher and Harvey L. Robinson.

THE WASHINGTON POWER TRANSMISSION COMPANY, Jersey City, N. J., has been formed, with a capital stock of $1,250,000. The incorporators are Frederic B. Hyde, Harry W. Meen and Kenneth K. McLaren.

THE GLENCOE ELECTRIC LIGHT COMPANY, Glencoe, Minn., has been incorporated by W. C. Russell, B. F. Allen, E. E. McIntire, G. K. Gilbert, Frank Kasper and J. A. Wadsworth, Glencoe. Capital stock, $8,000.

THE SIOUX CITY TRANSIT COMPANY, Des Moines, Ia., has been incorporated, with a capital stock of $200,000. The incorporators are A. W. Giehm, A. S. Wilson, A. M. Jackson, H. J. Froelich and J. O. Greusel.

THE NEW LIGHT, HEAT & POWER COMPANY, of Newark, N. J., has been formed, with a capital stock of $25,000. The directors are Daniel P. Smith, Frank Garlock, Abraham Garlock, John Sheffield and William A. Roe.

THE PEOPLE'S LIGHT COMPANY, Pittsburg, Pa., has been incorporated, with a capital stock of $150,000. The incorporators are Abram Nesbitt, W. P. Billings, Kingston; E. W. Mulligan, L. Flick, John Flanigan, Wilkesbarre.

THE BURGESS HEAT, LIGHT & POWER COMPANY, of New York, N. Y., has been incorporated in West Virginia for the purpose of manufacturing, building, constructing and buying machines for generating gas and electricity.

THE CHASE ELECTRIC CONSTRUCTION COMPANY, Plainfield, N. J., has been incorporated, with a capital stock of $500. Among those interested are Frederick F. Chase, Hattie T. B. Chase, Fanwood; Louis T. B. Chase and Juliette Chase.

THE PUEBLO TRACTION & ELECTRIC COMPANY, Pueblo, Col., has been incorporated, with a capital stock of $500,000. This new company is a consolidation of the Pueblo Light & Power Company, and the Pueblo Electric Street Railway Company.

THE AMERICAN DISTRICT TELEGRAPH COMPANY, of Iowa, has been incorporated at Des Moines, Ia., with a capital stock of $100,000. The incorporators are James J. Welch, president; Harry C. Briggs, vice-president; and E. C. McClain, secretary.

THE EMPIRE GAS & ELECTRIC FITTING COMPANY, New York, N. Y., has been formed, with a capital stock of $10,000. The incorporators are W. E. Dwight, New York; Albert H. Petereit, New York, and William S. Nicholls, Hoosick Falls, N. Y.

THE GRAND ISLAND GAS COMPANY, Grand Island, Neb., has been incorporated for the purpose of erecting and purchasing gas and electric light

works. The incorporators are C. B. Hensiger, N. S. Durnin, Heyward, G. Leavitt, A. D. Abbott, all of Grand Island.

THE RUTHERFORD & SUBURBAN ELECTRIC LIGHT & GAS COMPANY, East Rutherford, N. J., has been incorporated, with a capital stock of $200,000. The incorporators are Cornelius Fitzgerald, Rutherford; Andrew L. Fennessy, New York; William E. R. Smith, East Orange.

THE ARDSLEY ELECTRIC COMPANY, Greenburgh, N. Y., has been incorporated, with a capital stock of $50,000. The incorporators are Newton Clark Lyon, Montclair, N. J.; Samuel T. Davis, Jr., Ardsley-on-the-Hudson, N. Y., and Louis A. Beebe, Dobbs Ferry, N. Y.

THE CITY LIGHTING COMPANY, New York, N. Y., has been formed with a capital stock of $1,000,000. The company is to operate in Kings, Queens, Richmond and Westchester counties. The directors are John M. Ryan, New York City, and Frank L. Hearns and John S. Griggs, Jr., of Brooklyn.

THE CONNECTICUT AUTOMATIC TELEPHONE EXCHANGE COMPANY, Meriden, Conn., has been incorporated, with a capital stock of $250,000. The stockholders are Charles W. Royce, Edward L. Allen and Stephen C. Wolcott, Newton Centre, Mass.; William G. Nash and Ira B. Cushing, Brookline, Mass.

THE MONTGOMERY COUNTY ELECTRIC LIGHT & POWER COMPANY, which is to operate in the towns of Canajoharie and Palatine, Montgomery County, N. Y., and their immediate vicinity, was incorporated, with a capital stock of $25,000. The directors are Adelbert G. Richmond, Edward B. Burnap and James H. Cook.

THE TELEGRAPH AND TELEPHONE.

PROVIDENCE, R. I.—A franchise has been granted to the Providence Telephone Company to construct a subway.

HOMESTEAD, PA.—The Home Telephone Company, of this city, has opened up for business, with 300 subscribers to begin with.

FORT WAYNE, MICH.—The Central Union Telephone Company is seeking a franchise in this place, but the home company is opposing it.

BOUND BROOK, N. J.—The New York & New Jersey Telephone Company is making plans for the building of a trunk line between Roselle and this city.

TAUNTON, MASS.—A franchise has been granted to the Massachusetts Telephone & Telegraph Company, with the privilege of laying conduits in the streets.

SPRINGFIELD, OHIO.—The Central Union Telephone Company has obtained a franchise from the City Council giving it the privilege of placing its wires underground.

LE ROY, N. Y.—The Bell Telephone Company, in compliance with a petition from subscribers in this place, has reduced the rates for residences from $1.50 to $1 per month.

HOUSTON, TEX.—The Southwestern Telegraph & Telephone Company is stringing a second circuit of the long-distance line, which will connect Corpus Christi directly with the long-distance system.

BELOIT, WIS.—The City Council has granted a franchise to the Beloit Telephone Company to build a telephone exchange in this city, and connect the same with the new long-distance line now being constructed.

INDIANAPOLIS, IND.—The New Telephone Company announces that it expects to open for business in this city on April 1 with 2000 instruments. The exchange, which is at 230 North Meridian Street, is now practically completed.

DURHAM, N. C.—At the recent election of officers for the Interstate Telephone Company the following named gentlemen were selected: Mr. L. A. Carr, president; George W. Watts, vice-president; J. S. Carr, treasurer, and W. W. Shaw, secretary.

PEORIA, ILL.—The Automatic Telephone Company has received a franchise from the city. Among the provisions of the measure is that a subway shall be provided, and the rates are not to exceed $36 a year for business instruments and $24 for residences.

LOUISVILLE, KY.—The Ohio Valley Telephone Company has begun in this city the enforcement of an old rule requiring that telephones in drug stores must not be used by any one except subscribers. The druggists are a unit against the enforcement of the regulation.

ST. PAUL, MINN.—The Mississippi Valley Telephone Company has leased a four-story brick building on Third Avenue south which it will prepare for its own use. The company has just received a shipment of 500 telephones from Chicago, and the work of the installation of the plant will be pushed forward.

MEMPHIS, TENN.—The Cumberland Telephone & Telegraph Company has completed its long-distance line from New Orleans to Memphis. It is expected that the long-distance company's lines will be strung at an early date, thus giving communication between New Orleans and all points on the long-distance system.

NEWARK, N. J.—The annual meeting of the stockholders of the Newark District Telegraph Company was held in this city on March 9, and the following named directors were elected for the ensuing year: George W. Hubbell, Thomas T. Kinney, Edward Weston, Marcus L. Ward, Frederick T. Fearey and Fernanda C. Runyon.

NEW HAVEN, CONN.—A bill has been introduced in the state legislature to incorporate a new telephone company with substantially the powers of the Southern New England Telephone Company, to maintain a telephone service in this state. The new company agrees to make a considerable reduction in telephone rates. It is expected that the old company will make a vigorous resistance to the new enterprise. Among the incorporators are several prominent Boston men.

NORWICH, N. Y.—The manager of the Marsuis telephone system has been notified to remove his telephones from the offices and stations of the Delaware, Lackawanna & Western Railroad and the New York, Ontario & Western Railroad. The superintendents of these two railroads gave as their reasons for this notice that the Central New York Telephone Company has made contracts with the railroads under which it is entitled to the exclusive privilege of placing telephones in the railroad offices and stations.

CHAGRIN FALLS, OHIO.—The Chagrin Falls Telephone Company expects to extend its line to some farms that are calling for connection. Its rates are $12 a year for residence instruments and $18 for business. The company has been in business since December 13, 1895, and uses a Harrison switchboard of 100-drop capacity. It now has ninety-two subscribers, and the length of its lines is about 160 miles. Mr. C. H. Hubbell is manager of the company, which connects with the Bainbridge Telephone Company and the Newbury Telephone line.

ATLANTA, GA.—The Southern Bell Telephone & Telegraph Company has been awarded a verdict of $500 in a damage suit against the Atlanta Consolidated Street Railway Company. The suit arose from an accident in 1893, when a trolley on one of the railway company's cars slipped and broke a telephone wire. The telephone wire fell on the trolley wire and the heavy current caused a fire in the exchange which resulted in a damage to the extent of $2300. In charging the jury, the judge stated that both corporations were to blame, but the telephone company was the least culpable.

ELECTRIC LIGHT AND POWER.

STURGIS, S. D.—Mr. Sam Oliver, of Rapid City, S. D., has purchased the plant and franchises of the Sturgis Electric Light & Railway Company.

MEDIAPOLIS, IOWA.—An election will be held on March 27 to vote on the question of granting a franchise to an electric light company to establish a plant in this city.

MARYSVILLE, CAL.—The Yuba Electric Power Company, of this city, is the successor of the Yuba Power Company. Marysville is the company's headquarters, and not Yuba City.

SENECA FALLS, N. Y.—The property of the Seneca Light & Power Company, including the electric light plant at Waterloo, will be sold on April 8 on a foreclosure judgment obtained by the Old Colony Trust Company.

AUSTIN, TEXAS.—This city has been without street lights for over two months. During a part of this time the street railway company has been compelled to operate a reduced number of cars, all owing to the lack of water at the city lighting plant.

HOUMA, LA.—The Houma Lighting & Ice Manufacturing Company, Limited, has closed contracts with the General Electric Company for an electric plant of 1000 lights capacity. The company is now operating the ice manufactory and proposes to run the electric plant in connection with it.

TAMPICO, MEXICO.—The electric lighting plant at this place, which was recently purchased by Mr. T. C. Henry, of Denver, Col., is to be extensively improved and enlarged. It is also the intention of the new owner to establish an electric street railway system in this city.

HACKENSACK, N. J.—The Rutherford electric light plant was sold at public auction on March 8 under foreclosure proceedings, instituted by the Franklin Trust Company, of New York, which held a mortgage of $37,000 on the plant. The property went to the Trust Company, whose representative bid $61,000.

McKEESPORT, PA.—The McKeesport Electric Light Company has passed into the control of the Philadelphia company. The capital of the McKeesport company was $150,000. Both the Union and Tube City Natural and McKeesport Illuminating Gas companies and the street car systems are now owned by the Philadelphia company.

WOBURN, MASS.—The new plant of the Woburn Light, Heat & Power Company is completed. The new building, which is built of brick, has ample capacity to meet the requirements of Woburn, Stoneham and Winchester for many years to come. The plant includes three Westinghouse generators, direct-connected to 300-hp engines, and three large boilers. One of the generators will be used exclusively for the supply of power to the Lynn & Boston and North Woburn electric roads.

EASTON, PA.—A Philadelphia syndicate, headed by Stern & Silverman, has purchased the Edison Illuminating Company and the Easton Transit Company. The Edison company has been paying 5 per cent. dividends on $312,000 capital stock, in addition to paying for extensions and improvement. The Easton Transit Company operates nearly twenty miles of electric railway in Easton and Phillipsburg, N. J. The road is bonded for $300,000. It is understood that one of the first things to be done is the building of an electric road to Nazareth and the slate regions.

THE ELECTRIC RAILWAY.

MASSILLON, OHIO.—An electric railway from this city to Canal Dover is projected, Cleveland and Massillon capital being interested. It is stated that the proposed line will compete for passenger traffic with the Cleveland, Lorain & Wheeling Railway.

NEWBURYPORT, MASS.—The Newburyport & Amesbury Street Railway Company will be sold at auction on March 28 by order of the Circuit Court of the United States. The line is about 18½ miles long. The sale will also include the land and buildings belonging to the company.

NEW YORK, N. Y.—Evidence of the control of the Nassau Street railway system by the Brooklyn Heights Company is manifest in the fact that the cars of the Brooklyn Heights Company are now seen on the Fifth and Seventh Avenue lines in Brooklyn Borough, which lines formerly constituted a part of the Nassau system.

NEW ROCHELLE, N. Y.—Application has been made for an injunction restraining the Phoenix Telephone Company from putting in subways or erecting poles on the main streets of this place. The application was made by two

taxpayers, who allege that the defendant is a West Virginia corporation, has no legal title, and has not complied with the laws of the State of New York, and that its franchise is irregular.

NEW BRITAIN, CONN.—The Central Railway & Electric Company, of this city, employs an emergency telephone system on its lines. At each end of the several lines a telephone is connected with the instrument in the car house. There are also at several stations along the various lines instruments connected in the same circuit, so that if a car becomes disabled or any accident occurs upon the road word can be sent to the car house with very little delay.

LEGAL NOTES.

FENDERS ON BROOKLYN CARS.—The Appellate Division of the Supreme Court in Brooklyn Borough, New York City, has reversed a decision rendered under the city ordinance which provides that every trolley car running within the limits of the Borough of Brooklyn must be fitted with fenders, and that the fenders must not be more than three inches above the tracks. The decision was on the appeal of the Nassau Electric Railroad from a fine of $25, imposed upon the company by the County Court for a violation of the fender rule. Judge Goodrich, of the Appellate Division, in his decision says that the law is not reasonable. No trolley company can be certain that the height of its fenders will be less than three inches above the tracks, and the validity of the law, he states, depends upon its reasonableness. In conclusion he states that it is not less the duty of the Brooklyn trolley roads to run their cars with the least possible risk to pedestrians.

RESPONSIBILITY FOR TRANSMITTING LIBELLOUS TELEGRAMS.—An interesting case, involving the responsibility of transmitting libellous messages by telegraph, has been decided by the Minnesota Supreme Court in the case of Peterson vs. The Western Union Telegraph Company. The telegraph company's agent at New Ulm, Minn., received and transmitted a telegram to the plaintiff, anonymously signed, to the following effect: "Slippery Sam. Your name is pants." A verdict was rendered in favor of the plaintiff for $2,000, and the defendant appealed from the judgment. The Supreme Court held that the amount of the verdict was excessive, but affirmed the judgment on condition that plaintiff should stipulate to remit all in excess of $1,000. In the opinion Judge Buck states that when a master substitutes an agent or servant in his own place and clothes him with power to act for the master's benefit in serving the public, he is not permitted to shelter himself behind the plea of non-liability for the act of the agent, and the rule of respondent superior should not be relaxed whether the master is a corporation or an individual.

PERSONAL NOTES.

MR. L. B. STILLWELL is named as one of the consulting engineers of the Manhattan Elevated Company, which has now decided to equip with a third rail system. It is understood, however, that Mr. Stillwell will remain in closest touch with his important duties at Niagara, where so much of the power work is being done under his direction.

MR. E. D. TROWBRIDGE, manager of the American Telephone & Telegraph Company, at Cleveland, has been appointed superintendent of long distance service of the Michigan Telephone Company. The Michigan company, since becoming a part of the Erie system, has arranged to extend its toll lines to all parts of the State, and in a few months will have one of the most complete toll plants in the country. A department devoted entirely to this feature of the business has been created, and Mr. Trowbridge has been wisely designated as its head.

OBITUARY NOTE.

CAPTAIN SAMUEL TROTT, commander of the Anglo-American Cable Company's steamer "Minia," and well known to the telegraphic fraternity through his long connection with deep sea cable laying, died at Miami, Fla., on the morning of March 11. Deceased was born in Sussex county, England, in 1832, and began the seafaring life when he was seventeen years old. He was commander of the cable steamer "Faraday" from 1874 to 1880, during which time he laid the French and Direct cables. In the latter year he became commander of the cable steamer "Minia." Captain Trott was celebrated for his expertness in repairing broken and damaged deep sea cables. In 1876, in the middle of winter, he left London to repair the Direct cable in midocean. The task was successfully accomplished, and he was back in London in thirty-five days. The work was done in tempestuous weather, and was properly considered a great feat. Deceased was co-inventor, with Electrician F. A. Hamilton, of the "Minia," of a deep sea cable. Captain Trott was ill all winter. He was a great admirer of the United States, and long before Anglo-American union was preached advocated it with all the force of his vigorous personality and rugged eloquence. A fine type of the "sea king" has gone to his rest.

Trade and Industrial Notes.

THE VICTOR ELECTRIC COMPANY, of Chicago, has increased its capital stock from $6100 to $16,000.

THE AARON ELECTRIC COMPANY, Chicago, is the name of the successor to the business of the Cass & Aaron Company, of the same city.

MR. W. N. MATTHEWS has opened an office in the Commercial Building, St. Louis, Mo., where he will carry on a business of handling second-hand material and general electrical supplies.

MR. A. LOUIS KUEHMSTED, manager of the Charles E. Gregory Company, Chicago, reports that he has just purchased the stock of dynamos and motors of the National Electric Company, of Eau Claire, Wis.

THE STAR ARC LAMP SYNDICATE, LIMITED, 23 Ann Street, New York, announces for sale the patents of an arc lamp for either direct or alternating current without alteration, which burns from 60 to 100 hours, without an inner globe.

THE EUREKA TEMPERED COPPER WORKS, Northeast, Pa., have issued a catalogue and price list of their copper and brass products. The works produce commutator segments for dynamos and motors of all makes, copper brushes for all machines, trolley wheels, knife switches, etc., etc.

MR. A. C. GARRISON, vice-president and treasurer of the Columbia Incandescent Lamp Company, of St. Louis, Mo., was a visitor in the East last week, with Mrs. Garrison, spending a little time in New York City. He is very hopeful as to the general outlook and the growing demand for electric light.

MR. H. W. SHONNARD, formerly superintendent of the works in Brooklyn Borough of J. Jones & Son, New York, is established in a convenient and well-equipped experimental shop at 60 and 62 N. J. R. R. Avenue, Newark, N. J. Mr. Shonnard will develop model work and inventions with absolute secrecy.

DISSOLUTION OF PARTNERSHIP.—The partnership heretofore existing between Messrs. John Y. Parke and Thomas J. Allen, under the firm name of John Y. Parke & Co., of Philadelphia, was dissolved on March 10, by mutual consent. The business will be continued by Mr. John Y. Parke under the old title.

MR. JAMES G. BIDDLE, Philadelphia, has moved his office to Room 1038, Drexel Building. He formerly occupied Room 910 in the same building. Mr. Biddle is one of the best equipped specialists in handling electrical measuring instruments, and does business with prominent institutions and companies throughout the country.

INTERIOR CONDUIT IN CHICAGO.—The Western Electric Company is said to be the only concern in Chicago that carries a stock of interior conduit. As is well known, standard rubber-covered wires can be placed in these conduits without violating the underwriters' rules. It would be to the advantage of contractors to consult the Western Electric Company regarding conduits and wires.

MR. CHARLES WIRT, 1028 Filbert Street, Philadelphia, has issued a new price list of the Wirt brush. The prices of this new list have been reduced throughout in accordance with careful figuring based on reduced cost of manufacture. It is a rather singular circumstance in this connection that the prices on a staple article in this line can be reduced at a time when the component metals exhibit a skyward tendency.

THE "ADVANCE" WELSBACH BURNER IGNITER.—An attachment for electrically igniting Welsbach burners is a desirable improvement, as the old method of lighting them with a taper always causes more or less of an explosion, which is detrimental to the burner mantle. The Electric Appliance Company, Chicago, is pushing the sale of the Advance attachment for Welsbach burners, and finds that it sells very rapidly.

MESSRS. MEYSENBURG & BADT, Monadnock Block, Chicago, Western agents for the Weston Electrical Instrument Company, of Newark, N. J., have just issued a very complete catalogue of Weston standard electrical instruments. Each class of instrument is fully described and illustrated, and diagrams show the construction and method of connecting the instruments to circuits. The list shows every type of instrument manufactured by the Weston Company.

THE ILLINOIS INSULATED WIRE COMPANY, of Sycamore, Ill., has under construction an addition to its main factory, and now has a lot of machinery on the floor awaiting the completion of the building. The demand for its weatherproof wire has crowded its old quarters to the utmost, and this extension of its facilities will enable the company to supply many new customers as well as its old ones.

THE VARLEY DUPLEX MAGNET COMPANY, 138 Seventh Street, Jersey City, N. J., has recently placed upon the market a special Ruhmkorff coil built to give a spark of 1 inch to 1½ inches in length for ignition purposes. It is designed especially for gas and gasoline engine work. The company states that it has had much success with this coil. The coil is the result of careful study of all the wants of engine builders, and the company believes that it is far superior to the imported coil, generally used in this country.

THE PAGE ELECTRIC COMPANY, Worcester, Mass., has been awarded the contract to install all the electrical apparatus in the large hotel now being built at North Adams, Mass. The contract calls for the installation of 1000 incandescent lights, 150 telephones for the various rooms in the hotel and 14 automatic fire alarm gongs. The Page company reports that its business is unusually brisk. It is wiring the St. Vincent's Hospital for lights, bells and annunciators, and is wiring the Frohsinn Block in Worcester for about 8000 lights. Iron conduits will be used in the latter installation.

JOHNSON & MORTON is the name of a stock company formed by Messrs. Montgomery H. Johnson and Walter H. Morton at Utica, N. Y. The capital stock of the company is $10,000, and the directors, besides the two gentlemen named, are Griffith G. Williams, Henry A. Hatfield and J. Depuyster Lynch. The firm's headquarters are at 31-37 Catharine Street, and it has largely increased its facilities for manufacturing so as to enable it to meet the demand for its new type of junction boxes, which was described and illustrated in the last issue of the ELECTRICAL WORLD AND ELECTRICAL ENGINEER.

THE MICHIGAN PIPE COMPANY, Bay City, Mich., has just issued a catalogue describing and illustrating its creosoted wood conduits for electrical work. These conduits are treated by the Bethel process. They are made in 8-foot lengths, and do not require a concrete foundation. It is claimed that they last indefinitely, and the cables are not affected in any way. All those interested in underground conduit work would do well to consult the Michigan Pipe Company and obtain a copy of its latest catalogue, which gives a great deal of valuable and interesting information on the subject.

THE WESTERN ELECTRIC COMPANY, Chicago, has just issued Bulletin 15 I. S., describing type F instrument switches. These switches have been designed to meet the demand for a substantial voltmeter and ammeter

switch. The contact points of opposite polarity are mounted on separate slabs of white marble, which are fastened on the back of the switchboard. The switch is controlled from the face of the board by a hand wheel and index plate. Various views of the instrument are given in the bulletin, together with a price list of the sizes, which range from two-circuit switches to twelve-circuit switches.

THE CHICAGO EDISON COMPANY has recently closed a contract for the complete electrical equipment of the "Evening Star" newspaper building, in Washington, D. C. The contract provides for wiring 1400 16-cp lamps and 250 horse-power in motors; also for the bell signal system, telephone wiring, and conduit work for telegraph wires; all wiring to be done in iron-armored conduit. It includes also a very elaborate switchboard, with cable connection to a storage battery plant. The switchboard has three dynamo panels, 75 kilowatts each, besides various feeder panels for the lighting and power feeders. The building is to be erected on Pennsylvania Avenue, opposite the new Post Office. It will be ten stories high. The general contract was awarded to the Geo. A. Fuller Company, and the Chicago Edison Company is sub-contractor.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, is making arrangements to enlarge its factory facilities to more than double the present capacity. The company is adding considerable new and improved machinery to meet the demands for apparatus during the coming season. Among the unfilled orders is the equipment for exchanges now being installed in St. Paul and Minneapolis, Minn., for which the company is making 5000-wire capacity, semi-multiple switchboards with central-energy apparatus. It is also building a 1500-line multiple board and central-energy telephone equipment for Waco, Texas; a 600-line transfer switchboard with central-energy telephones for Parkersburg, W. Va.; a 200 central-energy equipment for Albion, Mich.; a similar equipment for North Vernon, Ind., and one of 100 capacity for Milford, Ill.

THE BATES MACHINE COMPANY, Joliet, Ill., manufactures the Cookson improved feed-water heater, purifier, filter and oil separator. Among the advantages claimed for this combination heater are higher temperature of feed water without back pressure on the engines, and that it will heat more water with less steam. It is claimed to be the only heater that purifies the steam before passing through the heating system, and without chilling it. It is also claimed to be the only heater made that will separate the oil from the exhaust steam on entering the heater, from either exhaust opening, one the oil separator and the other the steam separator, and opening by the steam passing through it in either direction. It is built on the interchangeable plan, and is easily repaired. This heater is constructed in such a manner that it can be taken entirely apart with a monkey-wrench. The company gives on a sheet an excellent lithographic illustration of the heater. The picture is so large and shows the details of construction so well that the features of the apparatus can be intelligently studied by any one interested.

THE WARD LEONARD ELECTRIC COMPANY.—This company not long ago entered the field of manufacturing enameled iron signs. There are only five manufacturers of these goods in the United States, and they operate closely guarded secret processes. The familiarity with enameling processes gained by the Ward Leonard Company in the manufacture of its enameled rheostats enabled it to quickly overcome the difficulties attending the manufacture of enameled iron signs, and it is now enjoying an excellent business in this line. The use of enameled signs for street names, signs upon street cars, etc., where a permanent, conspicuous and handsome sign is desired, which will not be affected by exposure to the elements, is rapidly increasing in this country, and bids fair to become a large industry. Telephone and street railway companies use great numbers of these signs, and they are rapidly growing in favor for numbering and naming dynamos, feeders, circuits, etc. The Ward Leonard Company has issued a complete price list for these signs. The Ward Leonard motor starters, with automatic release, have been lately reduced in price by a reduction varying from 30 to 50 per cent. This great reduction is due to new inventions and the cheapening due to large volume of business. A motor-starting rheostat with automatic release, selling at 50 cents per horse-power, seems amazingly cheap, yet this is the figure which has been reached in this line of business.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED MARCH 7, 1899.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

620,577. ANNUNCIATOR; S. B. Fowler, of New York, N. Y. App. filed October 25, 1898. An annunciator drop comprising a tube, a coil about said tube and adapted to be included in an electrical circuit, and a balanced shutter of magnetic material supported in the field of said coil.

620,593. ELECTRICAL STORAGE BATTERY AND PLATE THEREFOR; R. Kennedy, of Bradford, Eng. App. filed September 9, 1897. In plates for electrical storage batteries the combination of a central solid lead sheet painted on one side with litharge and dilute sulphuric acid, and on the other side with red lead and dilute sulphuric acid with one or more layers or thicknesses of perforated lead sheets also painted with the aforesaid mixtures of litharge and red lead and sulphuric acid on each side of the central sheet, the litharge-painted sheets being placed on the litharge-painted side of the central sheet and the red-lead-painted sheets on the other side thereof, the whole being in electrical contact and made solid around the edges by fusing or soldering.

620,609. MOTOR; E. S. Pillsbury and F. Schwedtmann, of St. Louis, Mo. App. filed March 18, 1898. The combination with a field magnet core and its support, or supports, of an eccentric ring interposed between said core and its support, or supports, substantially as described.

620,626. ELECTRIC MEASURING INSTRUMENT; C. R. Weymouth, of Alameda, Cal. App. filed November 30, 1898. The combination in an electrical measuring instrument, having fixed and movable coils of a divided circuit, one branch containing a fixed coil, the other branch containing a fixed coil and a movable coil, substantially as described.

620,628. APPARATUS FOR CONTROLLING OPERATION OF MOTORS; C. E. Woods, of Chicago, Ill. App. filed February 12, 1898. The combination of a swinging lever, of a motor controller, a multiplying gear, all of whose members are rotatable, interposed between said controller and lever for increasing the speed of the controller relative to the speed of the actuating lever and a brake adapted to engage a motor-driven portion also operated by said actuating lever, substantially as described.

620,640. ELECTRIC INCANDESCENT LAMP; F. M. F. Cazin, of Hoboken, N. J. App. filed September 11, 1895. In an electric incandescent vacuum lamp an all-glass base part, being in the shape of a press-blown bottle, with an open neck, when made, and with a navel and with a threaded end to fit a metal cap, and a rim at the upper end for fusing thereto a glass bulb, the neck and the navel being the means of perfecting a double seal around the inleading wires.

620,654. ELECTRIC RAILWAY; R. M. Hunter, of Philadelphia, Pa. App. filed October 21, 1889. In an electric railway, a source of alternating currents, feeder conductors extending therefrom, a vehicle having an electromotor mounted thereon, through which an alternating current is transmitted, a transformer interposed between said feeder conductors and said electromotor, and in operative relation therewith, and means for modifying the current transmitted through the electromotor.

620,665. ELECTRIC ARC LAMP; M. S. Okun, of New York, N. Y. App. filed January 16, 1896. In an arc lamp, a solenoid and core, a carbon-feeding rod, a support carried by said core, a finger or dog having a toe and pivotally carried by said support, a level also pivotally carried by said support to act on said finger or dog, and an abutment for said lever, substantially as described.

620,679. APPARATUS FOR REMOVING ELECTRICITY FROM THE HUMAN SYSTEM; J. W. Shryock, of Pueblo, Col. App. filed July 21, 1898. In an apparatus for removing electricity from the human system, the combination of a grounded metallic element possessing sufficient surface area, an electrical conductor leading from the said element, a metal contact attached to the body and connected with the opposite extremity of said conductor, and a rheostat interposed between the grounded element and the body for regulating the flow of the current.

620,702. INDICATOR; A. Custodis, of Dusseldorf, Germany. App. filed February 19, 1898. An electric distance indicator composed of a needle in circuit, a vertically movable plate having a hub that surrounds the needle-shaft, insulated contacts supported upon the plate, a tapped adapted to alternately raise and lower the plate, a series of wires that separately connect the contacts with the electromagnets of a distant recording or indicating instrument, and a single return wire.

620,703. MUNICIPAL SIGNAL; E. Davis, of Boston, Mass. App. filed December 16, 1898. In a system for transmitting signals, the combination of a transmitter comprising a pair of gear wheels forming the terminals of a circuit and having their teeth engaged, one of said wheels having an incomplete number of teeth, whereby one or more breaks are made in the circuit, means for rotating said gear-wheels, and a receiver adapted to respond to the current impulses impressed on the circuit by said transmitter.

620,713. OVERFLOW ALARM; C. Liss, of New York, N. Y. App. filed December 28, 1898. A frame for overflow alarms, having an upper hook adapted to straddle the drip-pan, and a lower hook adapted to engage the alarm box, combined with a shaft hung in the frame, a contact lever supported upon the shaft, and a float suspended from the lever.

620,715. CONNECTOR FOR ELECTRICAL CONDUCTORS; P. Minich, of Independence, Mo. App. filed December 5, 1898. As a new article of manufacture a fish-plate for track rails having a longitudinal groove therein, and a recess communicating with said groove and having its sides extending below the line of said groove in oppositely curved lines adapted to facilitate the unfolding of an extensible folding conductor of electricity and an extension upon the opposite side of the fish-plate to that having said recess.

620,720. ELECTRIC HEATER; R. A. Parker, of Detroit, Mich. App. filed October 2, 1895. In an electric heater, the combination of a series of insulating supports constructed to hold a coiled resistance wire out of contact with adjacent coils, means for holding the supports in position, a spring-coiled resistance wire secured to one of said supports, and passing alternately over and under the intervening supports until it reaches the last support of the series, about which it passes, and returning continues in like manner until the wire has continuously passed from one end of said supports to the other, thus interweaving the wire about said supports, substantially as described.

620,733. TELEPHONE SYSTEM; C. L. Boyce, of Detroit, Mich. App. filed April 29, 1898. A combination of a local ringing and talking jack-circuit, which is normally open and has normally no earth connection; a source of electricity and earth connection, and means for closing said local ringing and talking jack-circuit to earth through said source of electricity, whereby said local ringing and talking jack-circuit becomes also the local busy-test circuit.

620,745. TELEPHONE CENTRAL OFFICE CIRCUIT; H. Middlebrook Crane, of Boston, Mass. App. filed Oct. 31, 1898. The combination in a multiple-switchboard system with a grounded test conductor uniting the

test pieces of the switch sockets of a telephone line; and a cut-off relay contained in the circuit thereof; of a normally disconnected source of test current; a main conductor, including a resistance device extending therefrom; a normally discontinuous branch thereof, including a signal-controlling relay and switching devices adapted when operated to close the circuit of said source through the said cut-off relay and signal-controlling relay in parallel branches, and to establish a testing potential upon the test pieces of the said switch sockets.

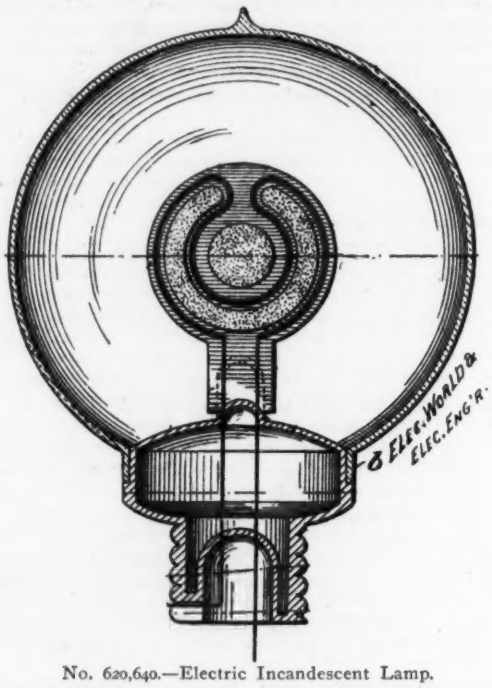
620,746. MEANS FOR IMPRESSING SEMI-CYCLES OF ELECTROMOTIVE FORCE ON ELECTRIC CIRCUITS; A. C. Crehore, of Hanover, N. H., and G. O. Squier, of the United States Army. App. filed Jan. 4, 1899. The combination with an alternating-current generator, producing two electromotive forces, sine-wave type and of the same periodicity; of means for converting said electromotive forces into two sets of connected semi-cycles two separate circuits, all of the semi-cycles in each being of the same polarity.

620,759. ELECTRIC ARC LAMP; C. Eschewel, of New York, N. Y. App. filed Feb. 3, 1898. In an electric arc lamp, the combination of a clutch for the upper carbon, a solenoid having a core provided with a flange and a connecting rod extending from the clutch and screwed into the said flange so that the upper end of said rod is adapted to strike against the solenoid, such screw connection between the rod and said flange permitting the adjustment of the rod in the flange.

620,778. TRANSMITTER FOR MULTIPLE TELEGRAPHS; W. A. Houghtaling, of New York, N. Y. App. filed Dec. 22, 1898. The combination in a telegraph-transmitter of a movable contact, a pair of fixed contacts, suitable electrical connections for said contact with the main line and with a source of electricity, respectively; a polarized magnet for controlling said movable contact having two coil windings; a source of electricity, separate branch conductors connected to said source and to said coils, respectively, to produce opposing magnetic effects, and a circuit breaker in one of said branches.

620,783 ELECTRICAL REGULATOR; W. H. K. King, of Carthage, Mo. App. filed Sept. 20, 1898. In an electrical regulator, the combination with receiving plates and delivery posts of vibrating spring contacts for changing the polarity of the current passing through the said posts, a clock mechanism mounted in the said casing, an escapement connecting the said mechanism with the said vibrating springs, a pendulum connected with the said escapement, and means for controlling the extent of movement of the pendulum, substantially as described.

620,806. ELECTRIC TRAIN-SIGNALING SYSTEM; B. C. Seaton, of St. Louis, Mo. App. filed Feb. 28, 1898. An electric train-signaling system,



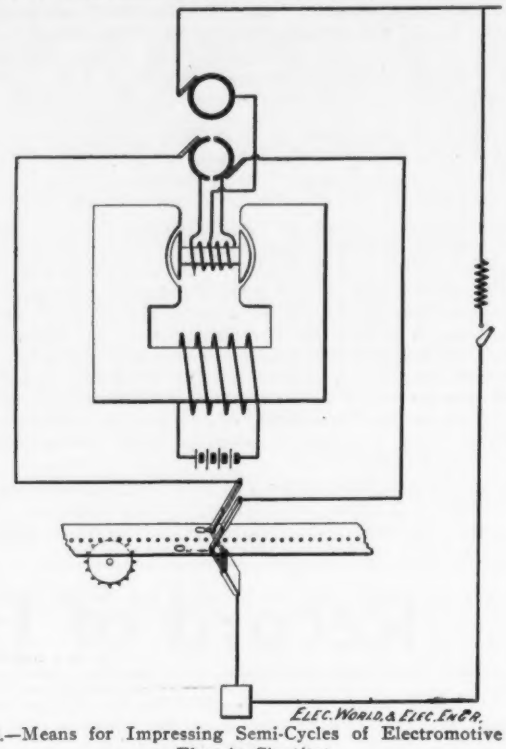
No. 620,640.—Electric Incandescent Lamp.

comprising the single-track rails having overlapping insulated sections and broken insulated joints; an auxiliary circuit rail and a signal station, having for each side of the signal station a switchboard provided with circuit-closing switches for the several sections; a bell or annunciator; a circuit-closing key, for communicating a signal from the signal station to a train; a switch for throwing the bell or annunciator in or out of circuit, and a connecting bar common to all the circuit-closing switches, whereby the latter are connected with the bell or annunciator, substantially as described.

620,829. VALVE; J. F. Batchelor, of New York, N. Y. App. filed Aug. 11, 1898. The combination, with a valve-casing and a main valve, of a cylinder having its rear portion normally in communication with the inlet chamber of the valve-casing, and containing a piston which is connected with the main valve; an auxiliary valve chamber formed integrally with said cylinder and communicating therewith and provided at its outer end with a removable head or cap having an exhaust port, and a valve controlling said port.

620,839. ELECTRIC SWITCH; W. B. Bernardini, of Lakewood, and W. Ely, of Providence, R. I. App. filed Aug. 11, 1896. In an electric switch, a stationary guideway, a rotatable shaft, an arm extending at right angles from said shaft and pivoted thereon in such manner that each is capable of partial rotation without reference to the movement of the other; a cross-head adapted for reciprocating movement in said stationary guideway, a link pivoted to said arm and cross-head and connecting the two, an actuating lever pivoted independently on said shaft and adapted for engagement with said arm, and an extensible spring connecting said lever and cross-head, all combined with each other and with a base.

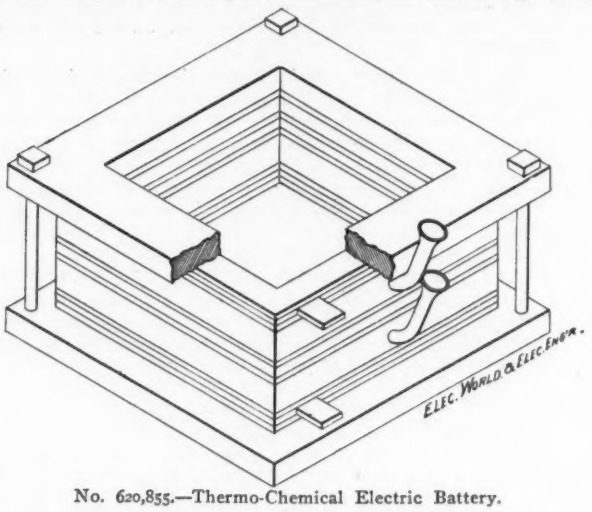
620,852. ELECTRIC RAILWAY; J. F. Munsie, of New York, N. Y. App. filed Oct. 25, 1898. An electric railway system comprising a series of contact boxes at determinate points along the track, containing circuit-closing



No. 620,746.—Means for Impressing Semi-Cycles of Electromotive Force on Electric Circuits.

devices to establish connections with a supply conductor, a circuit-operating device carried by each car, composed of a support secured to the two car trucks, and a sectional collector shoe hung thereon and movable relatively thereto, said shoe being composed of several lengths connected by slip joints movably pressed together by springs.

620,855. THERMO-CHEMICAL ELECTRIC BATTERY; M. L. Severy, of Boston, Mass. App. filed April 8, 1895. The combination of a series of thermal cells, each consisting of a closed receptacle having its front and back each formed by an electrode of the cell; means for supporting said series of cells in the same plane, and means for maintaining the faces of



No. 620,855.—Thermo-Chemical Electric Battery.

these cells constantly exposed to the solar rays in accordance with the apparent movement of the sun.

620,864. ELECTRIC CLOCK; J. Butcher, of Melrose, Mass. App. filed Sept. 22, 1897. In a clock, the combination with a bell, its hammer, and a rock shaft to which the hammer is attached, of an electromagnet, its armature carried by said rock shaft, a normally open electric circuit, including a generator and said electromagnet, said circuit having terminals adjacent to the path of some part of the pendulum of the clock, the said pendulum, a movable interposing piece adapted to be moved into the space between the pendulum and one of said terminals, whereby the pendulum is caused to close the said circuit at each of its vibrations, means for regulating the number of strokes on the bell and means independent of the pendulum for operating the said interposing piece.

620,865. RAILWAY-RAIL BOND. H. L. Des Anges, of Hoboken, N. J. App. filed June 18, 1895. In a railway, the combination of rails having grooves in the tops of the treads thereof, and a bond, for electrically connecting the rails, fitting tightly within said grooves.